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AMERICAN ELECTRO-THERAPEUTIC  
ASSOCIATION  
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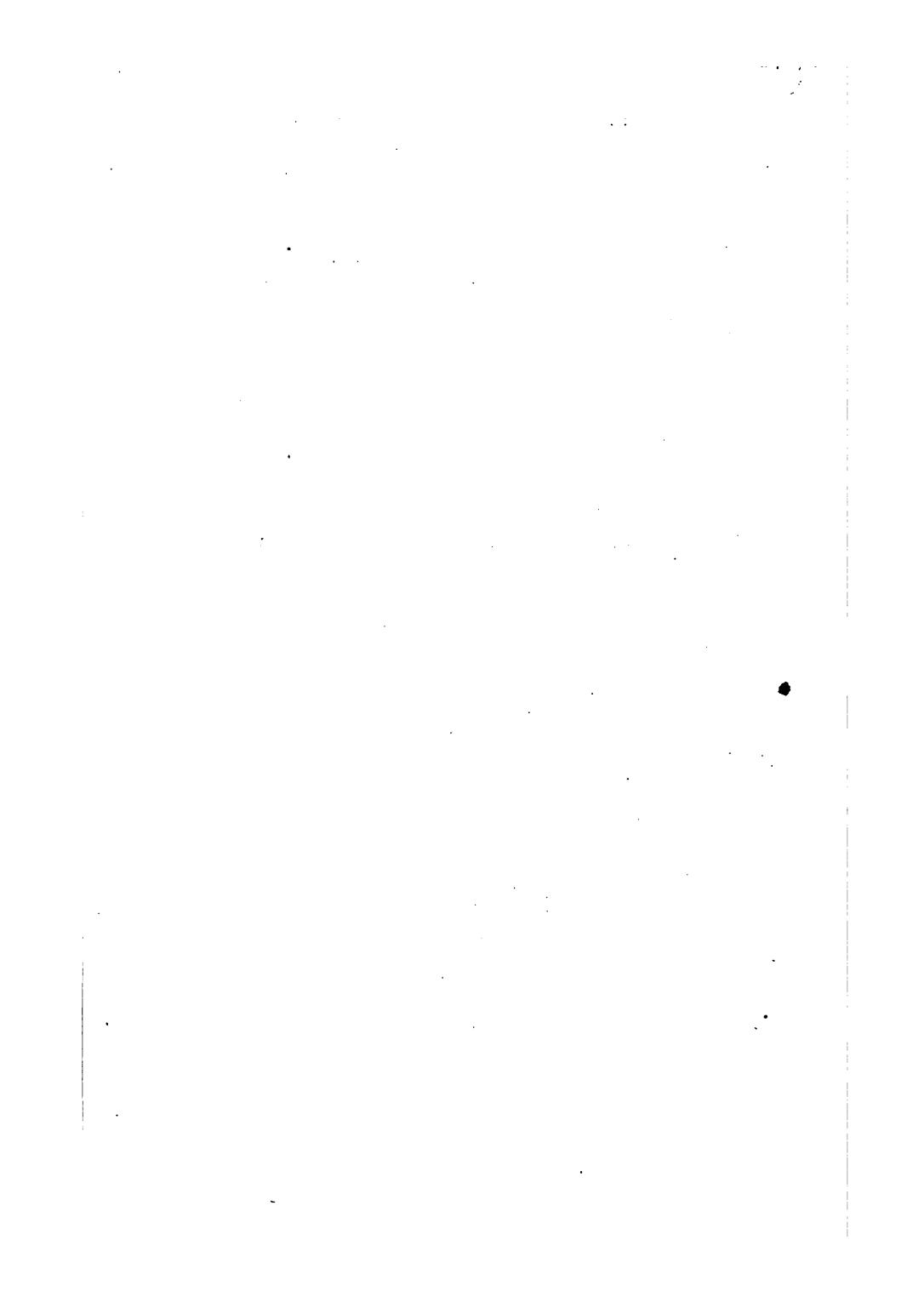
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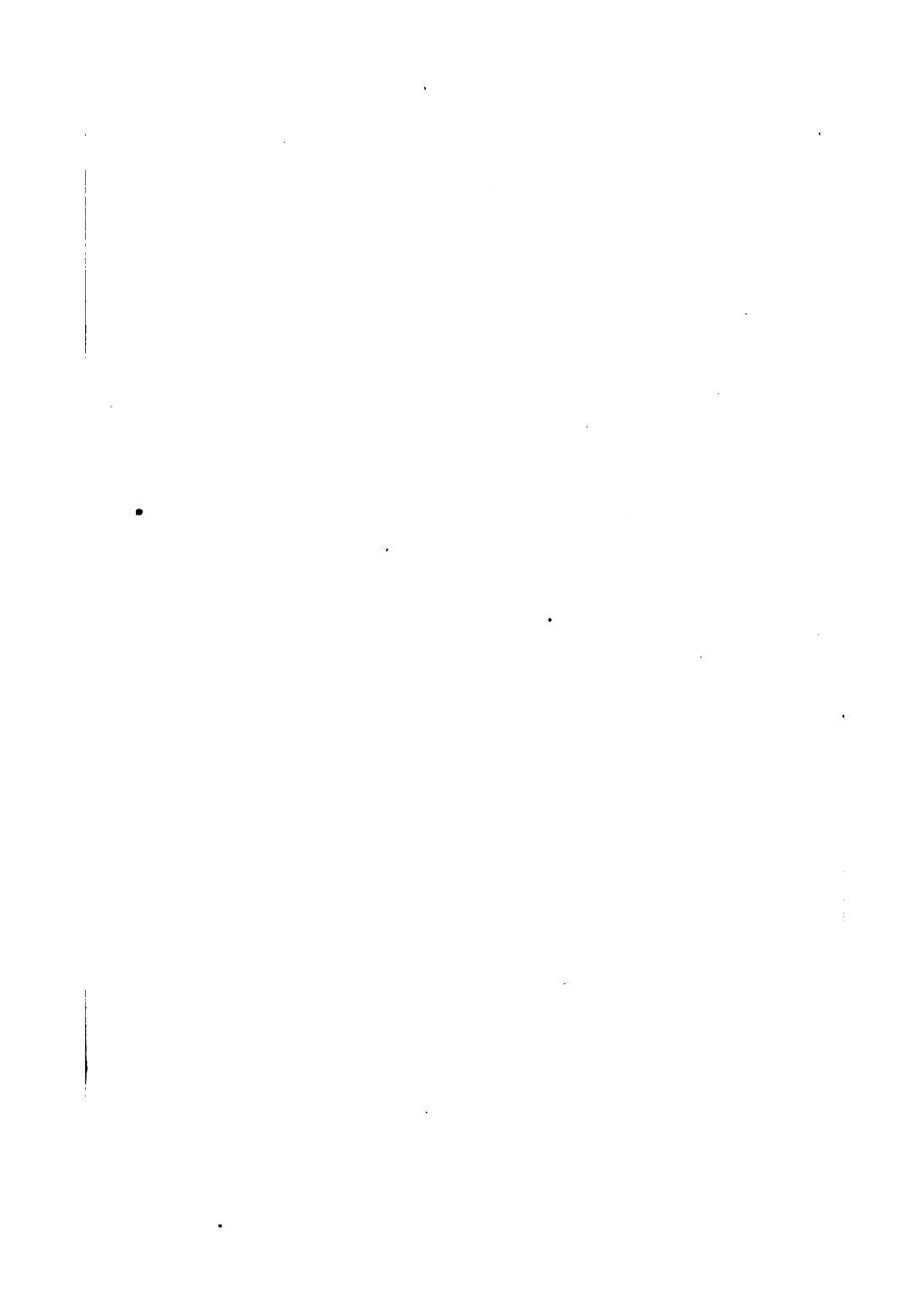






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TRANSACTIONS  
OF THE  
AMERICAN ELECTRO-THERAPEUTIC  
ASSOCIATION



EIGHTH ANNUAL MEETING

HELD AT BUFFALO, N.Y.

September 13th, 14th and 15th, 1898.

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PUBLISHED BY THE ASSOCIATION  
1899

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## CONTENTS.

	PAGE
Officers	vi
Committees	vii
Honorary Fellows	viii
Fellows	ix
Associate Fellows	xii
In Memoriam	xii
Constitution and By-laws	xiii
Proceedings of the Eighth Annual Meeting	xxv
<hr/>	
The President's Address—Aims and Claims. By Charles R. Dickson, M.D.	1
High Frequency Oscillators for Electro-Therapeutic and Other Purposes. By Nikola Tesla, E.E.	9
Phlebitis, a Clinical Study. By Margaret A. Cleaves, M.D.	28
New Uses of the Undulatory Current in Gynecology. By G. Apostoli, M.D.	42
Electricity in the Treatment of Uterine Fibro-myomata. By Felice La Torre, M.D.	57
Electricity Employed in Gynecology. By Georges Gautier, M.D., and J. Larat, M.D.	68
Treatment of Uterine Fibroids by Small Currents Administered Percutaneously. By R. J. Nunn, M.D.	70
Menorrhagia and its Treatment by Weak Galvanic Current with Intra-uterine Positive Silver Electrode. By Adelstan de Martigny, M.D.	83
On the Use of Cataphoresis in Certain Forms of Conjunctival Inflammation. By Lucien Howe, M.D.	86

133018

	PAGE
<b>Electricity in Deafness and Strictures of the Eustachian Tube.</b> By Robert Newman, M.D. - - - - -	90
<b>The Use of Electricity in Acne Vulgaris and Acne Rosacea.</b> By Grover William Wende, M.D. - - - - -	102
<b>Cases of Lightning-Stroke Causing Diseases of the Eye.</b> By G. Sterling Ryerson, M.D. - - - - -	112
<b>The Diagnostic and Therapeutic Relations of Electricity to the Diseases of the Central Nervous System.</b> By A. D. Rockwell, M.D. - - - - -	113
<b>High Tension Currents in the Treatment of Neuritis.</b> By Francis B. Bishop, M.D. - - - - -	125
<b>Electricity in the Treatment of Goitre.</b> By Charles R. Dickson, M.D. - - - - -	133
<b>Ten-Minute Talks Upon Electro-Therapy—</b>	
Introduction. By Charles R. Dickson, M.D. - - - - -	135
The Action of Electricity on Tissue Metabolism. By Wm. J. Herdman, M.D. - - - - -	136
The Galvanic Current in Gynecology. By G. Betton Massey, M.D. - - - - -	140
Some Surgical Uses of Electricity. By Charles R. Dickson, M.D. - - - - -	143
The Combined Use of Electrical and Medicinal Treatment in Some Affections of the Eye. By G. Herbert Burnham, M.D. - - - - -	146
Electricity in Genito-Urinary Diseases. By Robert Newman, M.D. - - - - -	149
The New Cataphoric Treatment of Cancer. By G. Betton Massey, M.D. - - - - -	157
Orthopaedic Uses of Electricity. By Louis A. Weigel, M.D. - - - - -	163
The Functional Neuroses, with Special reference to Neuralgathenia—Their Pathology and Treatment. By A. D. Rockwell, M.D. - - - - -	165
<b>Alternating Dynamo Currents.</b> By Francis B. Bishop, M.D. - - - - -	172

	PAGE
The Alternating Current. By G. Gautier, M.D., and J. Larat, M.D. . . . .	174
Hot-Air and Electric-Light Baths for Medical Use. By G. Gautier, M.D., and J. Larat, M.D. . . . .	175
The Electric Arc Bath—A Preliminary Report. By Margaret A. Cleaves, M.D. . . . .	179
The Electric-Light Bath. By J. H. Kellogg, M.D. . . . .	205
The Effect of High Tension Discharges on Bacteria. By J. Inglis Parsons, M.D., and C. Slater, M.B. . . . .	228
Report on the Action of X-Rays on Tuberculosis. By J. Ber- gonié, M.D., and — Teissier, M.D. . . . .	231
Two Years' Practice with the Roentgen Rays. By G. Gautier, M.D., and J. Larat, M.D. . . . .	271
Report of the Standing Committee on Meters. By Margaret A. Cleaves, M.D., and Edwin W. Hammer, E.E. . . . .	275
Report of the Standing Committee on Constant or Direct Current Generators and Controllers. By W. J. Herdman, M.D. . . . .	278
Supplementary Report of the Standing Committee on Constant Current Generators and Controllers. By Robert Newman, M.D. . . . .	281

## OFFICERS FOR 1898-99.

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### President:

FRANCIS B. BISHOP, M.D. - - - - Washington, D.C.

### Vice-Presidents:

ERNEST WENDE, M.D. - - - - Buffalo, N.Y.

WALTER H. WHITE, M.D. - - - - Boston, Mass.

### Treasurer:

RICHARD J. NUNN, M.D. - - - - Savannah, Ga.

### Secretary:

JOHN GERIN, M.D. - - - - 68 North Street, Auburn, N.Y.

### Executive Council:

ROBERT NEWMAN, M.D.	-	-	-	New York, N.Y.	} 3 Years.
G. BETTON MASSEY, M.D.	-	-	-	Philadelphia, Pa.	
A. D. ROCKWELL, M.D.	-	-	-	New York, N.Y.	} 2 Years.
WILLIAM J. MORTON, M.D.	-	-	-	New York, N.Y.	
CHARLES R. DICKSON, M.D.	-	-	-	Toronto, Canada.	} 1 Year.
FREDERICK SCHAVOIR, M.D.	-	-	-	Stamford, Conn.	

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Time and place of next meeting: Tuesday, Wednesday and Thursday, September  
19th, 20th and 21st, 1899, at Washington, D.C.

## COMMITTEES.

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### Committee on Induction Coils and Alternators:

MARGARET A. CLEAVES, M.D., *Chairman.*  
A. E. KENNELLY, F.R.A.S. BURTON KENRAIDE, E.E.

### Committee on Meters:

EMIL HEUEL, M.D., *Chairman.*  
CHARLES T. SCOTT, M.A.I., E.E. WM. J. JENKS, E.E.

### Committee on Constant Current Generators and Controllers:

WM. J. HERDMAN, M.D., *Chairman.*  
ROBERT NEWMAN, M.D. R. G. BROWN, E.E.

### Committee on Static Machines and Condensers:

WM. J. MORTON, M.D., *Chairman.*  
FREDERICK SCHAVOIR, M.D. G. BETTON MASSEY, M.D.

### Committee on Electrodes:

CHARLES REA DICKSON, M.D., *Chairman.*  
JOHN GERIN, M.D. R. G. BROWN, E.E.

### Committee on Electric-Light Apparatus for Diagnosis and Therapy and the Roentgen X-Ray:

AMOS E. DOLBEAR, M.A., PH.D., *Chairman.*  
W. H. WHITE, M.D. FREDERICK D. MORSE, M.D.

### Committee on Cataphoresis:

JOHN J. CARTY, E.E., *Chairman.*  
GRAEME M. HAMMOND, M.D. FREDERICK PETERSON, M.D.

### Committee on Arrangements:

D. PERCY HICKLING, M.D., *Chairman,*  
221 Third Street, N.W., Washington, D.C.  
J. TABOR JOHNSON, M.D. Z. T. SOWERS, M.D.  
G. L. MAGRUDER, M.D. ROBERT REYBURN, M.D.  
ELMEE SOTHORPE, M.D. CHARLES R. LUKE, M.D.  
LLEWELLYN ELIOT, M.D. G. BETTON MASSEY, M.D.

## HONORARY FELLOWS.

---

Apostoli, Dr. Georges, 5 Rue Moliere, Paris, France.  
D'Arsonval, Prof. Dr. A., 28 Avenue de l'Observation, Paris, France.  
Benedict, Prof. Dr. I., Franziskanerplatz 5, Vienna, Austria.  
Bergonié, Prof. Dr. J., 9 bis Rue du Temple, Bordeaux, France.  
Carhart, Prof. H. S., University of Michigan, Ann Arbor, Mich.  
Clark, Dr. W. Bruce, M.A., M.B., F.R.C.S., 51 Harley Street, W.,  
London, England.  
Dolbear, Prof. Amos E., A.B., A.M., M.E., Ph.D., Tufts College,  
Mass.  
Gautier, Dr. Georges, 7 bis Rue du Louvre, Paris, France.  
Houston, Prof. Edwin J., Ph.D., 1809 Spring Garden Street, Phila-  
delphia, Pa.  
Jenks, Wm. J., E.E., 120 Broadway, New York, N.Y.  
Keith, Mr. Skene, 42 Charles Street, Berkeley Sq., W., London,  
England.  
Kennelly, A. E., Sc.D., F.R.A.S., Crozer Building, Philadelphia, Pa.  
Langley, Prof. W., Case School of Applied Science, Cleveland, Ohio.  
Larat, Dr. J., Laboratoire d'Electrotherapie, 3 Place du Theatre  
Français, Paris, France.  
La Torre, Dr. Felice, 3 Via XX Settembre, Rome, Italy.  
Massin, Dr. Wassli, Wassli Astrow, St. Petersburg, Russia.  
McClure, Dr. Henry, Norwich, England.  
Mitchell, Dr. S. Weir, LL.D., 1524 Walnut Street, Philadelphia, Pa.  
Parsons, Dr. J. Inglis, 3 Queen Street, Mayfair, W., London, Eng.  
Soutakis, Dr., Constantinople, Turkey.  
Temesvary, Dr. Rudolff, Erzébetkorut 32, Budapest vii, Hungary.  
Tesla, Nikola, E.E., 55 West 27th Street, New York, N.Y.  
Thomson, Prof. Elihu, Lynn, Mass.

**FELLOWS.**

Bigelow, Dr. Horatio R., 36 Rue Jeanne d'Arc, Rouen, France.  
Bill, Dr. George E., Harrisburg, Pa.  
Bishop, Dr. Francis B., 1913 I Street, N. W., Washington, D.C.  
Bishop, Dr. William T., Harrisburg, Pa. President in 1897.  
Brown, Dr. Caleb, Sac City, Iowa.  
Brower, Dr. D. R., 597 Jackson Boulevard, Chicago, Ill.  
Cabot, Dr. Caroline A., 26 West 48th Street, New York City.  
Call, Dr. Emma L., 42 Newbury Street, Boston, Mass.  
Charlton, Dr. Thomas J., 220 Oglethorpe Avenue E., Savannah, Ga.  
Chauveau, Dr. Jean F., jun., 866 Boulevard, New York City.  
\*Cleaves, Dr. Margaret A., 78 Madison Avenue, New York City.  
Coe, Dr. Henry Waldo, 714 Marquam Building, Portland, Ore.  
Coope, Dr. F. A., 114 Sycamore Street, Oil City, Pa.  
Corson, Dr. Eugene R., 115 Jones Street, Savannah, Ga.  
Davis, Dr. J. Griffith, 200 West 14th Street, New York City.  
Dickson, Dr. Charles R., 296 Sherbourne Street, Toronto, Canada.  
President in 1898.  
Douglas, Dr. O. B., 123 East 36th Street, New York City.  
Fairbanks, Dr. C. O., 25 West 45th Street, New York City.  
Files, Dr. Charles O., Portland, Me.  
Ford, Dr. Willis E., 266 Genesee Street, Utica, N.Y.  
Free, Dr. Spencer M., Duboid, Pa.,  
Gehring, Dr. E. C., N. E. corner Westminster Place and Vandeventer  
Avenue, St. Louis, Mo.  
Gerin, Dr. John, 68 North Street, Auburn, N.Y.  
Grier, Dr. M. J., 1531 Spruce Street, Philadelphia, Pa.

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\* Present at the first meeting, and founders of the Association.

X

Hahn, Dr. H. H., 304 East Federal Street, Youngstown, O.

Hammond, Dr. G. M., 58 West 45th Street, New York City.

Herdman, Dr. Wm. J., 48 East Huron Street, Ann Arbor, Mich.  
President in 1894.

Heuel, Dr. Emil, 350 Willis Avenue, New York City.

Hickling, Dr. D. Percy, 221 Third Street, N.W., Washington, D.C.

Howe, Dr. Lucien, 183 Delaware Avenue, Buffalo, N.Y.

Jewett, Dr. Henry S., 21 South Ludlow Street, Dayton, O.

Kellogg, Dr. J. H., Battle Creek, Mich.

Lawhead, Dr. H. D., Woodland, Yolo County, Cal.

Lichty, Dr. John A., Clifton Springs, N.Y.

Livingston, Dr. Alfred J., Jamestown, N.Y.

Lodor, Dr. Charles H., 3136 Indiana Avenue, Chicago, Ill.

Martigny, Dr. Adelstan de, 406 Sherbrooke Street, Montreal, Canada.

Martin, Dr. Franklin, 34 Washington Street, Chicago, Ill.

\*Massey, Dr. G. Betton, 1636 Walnut Street, Philadelphia, Pa. President in 1891.

McGinnis, Dr. E. H. L., 329 Amsterdam Avenue, New York City.

\*Morton, Dr. William J., 17 East 28th Street, New York City.  
President in 1892.

Morse, Dr. Frederick D., Melrose, Mass.

\*Newman, Dr. Robert, 64 West 36th Street, New York City. President in 1896.

Newton, Dr. Robert Safford, 19 East 44th Street, New York City.

Neylan, Dr. D. J., 172 Hope Street, Bristol, R. I.

Nickerson, Dr. N., 16 West Main Street, Meriden, Conn.

Nunn, Dr. Richard J., 5 York Street, E., Savannah, Ga.

Osman, Dr. C. Frank, 21 Mayfield Street, Dorchester, Boston, Mass.

Perkins, Dr. Edward A., 677 Tremont Street, Boston, Mass.

Peterson, Dr. Frederick, 60 West 50th Street, New York City.

Phelps, Dr. O. S., 332 West 56th Street, New York City.

Phillips, Dr. Wendell C., 360 Madison Avenue, New York City.

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\* Present at the first meeting, and founders of the Association.

Pitcher, Dr. Herbert F., Haverhill, Mass.

Pope, Dr. Curran, 115 West Chestnut Street, Louisville, Ky.

Powell, Dr. Stephen C., Newport, R.I.

Reyburn, Dr. Robert, 714 13th Street, Washington, D.C.

Riggs, Dr. C. Eugene, The Endicott Arcade Building, St. Paul, Minn.

Robinson, Dr. W. F., 59 Washington Avenue, Albany, N.Y.

Rockwell, Dr. A. D., 25 East 44th Street, New York City.

Ross, Dr. Frank W., 164 Lake Street, Elmira, N.Y.

Schavoir, Dr. F., 8 Atlantic Street, Stamford, Conn.

Scheppegrell, Dr. W., A. M., 3723 Prytanis Street, New Orleans, La.

Sherman, Dr. A. L., 325 Ninth Street, Brooklyn, N.Y.

Shannon, Dr. J. E., 4 West Main Street, Sharon, Tenn.

Silvers, Dr. Elihu B., cor. Irving and Grand Streets, Rahway, N.J.

Thomas, Dr. J. G., Mobile, Ala.

Walker, Dr. Holford, 56 Isabella Street, Toronto, Canada.

Wallace, Dr. Frank H., 711 Boylston Street, Boston, Mass.

Watkins, Dr. R. L., 48 West 37th Street, New York City.

Watson, Dr. William S., Fishkill-on-Hudson, N.Y.

Weigel, Dr. Louis A., 209 East Avenue, Rochester, N.Y.

Wende, Dr. Ernest, 471 Delaware Avenue, Buffalo, N.Y.

White, Dr. W. H., 220 Marlborough Street, Boston, Mass.

Wood, Dr. Horatio R., 1005 Masonic Temple, Chicago, Ill.

Woolsey, Dr. Elliot H., 1103½, Oakland, Cal.

Weichselbaum, Dr. Jacob, 111 Whitaker Street, Savannah, Ga.

## ASSOCIATE FELLOWS.

---

Brown, R. G., E.E., 158 Montague Street, Brooklyn, N.Y.  
Cabot, John A., E.E., Chief Electrician, Board of Administration,  
Cincinnati, O.  
Carte, John J., E.E., Vice-President, New York Electrical Society,  
15 Dey Street, New York City.  
Hammer, Edwin W., E.E., 20 Broadway, New York City.  
Kenraide, Burton, E.E., 38 Park Avenue, Jamaica Plain, Boston, Mass.  
Lawrence, Newman, M.I., E.E., Ozone Park, Long Island, N.Y.  
Scott, Charles T., M.A.I., E.E., 6214 Sellers Street, Pittsburg, Pa.

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## In Memoriam.

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### Honorary Fellows.

Dr. Onimus, Paris, France, 1896.  
Dr. E. DuBois Reymond, Berlin, Germany, 1896.  
Dr. Thomas Keith, London, England, 1897.

### Fellows.

Dr. John Chambers, Indianapolis, Indiana, 1892.  
Dr. Plym S. Hayes, Chicago, Ill., 1893.  
Dr. William F. Hutchinson, Providence, R.I., 1893.  
Dr. S. T. Anderson, Bloomington, Ill., 1896.  
Dr. Charles W. Wiley, Vineland, N.J., 1897.

**THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.**

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**CONSTITUTION.**

1. The name of this Association shall be The American Electro-Therapeutic Association.
2. The object of this Association shall be the cultivation and promotion of knowledge in whatever relates to the application of electricity in medicine and surgery.

**MEMBERS.**

3. The members of this Association shall consist of Fellows, Life Fellows, Honorary Fellows and Associate Fellows.
4. Fellows shall be legally qualified practitioners of medicine and surgery in good standing, and shall not exceed one hundred and fifty in number.
5. Fellows, after five years of membership, shall be eligible for Life Fellows.
6. Honorary Fellows shall be eminent practitioners of medicine in good standing, or eminent electrical experts in good standing, and shall not exceed ten American and twenty-five foreign.
7. Associate Fellows shall be electrical experts in good standing, and shall not exceed twenty-five in number.
8. Fellows and Life Fellows alone shall be entitled to vote, or be eligible for any office except as member of committee, but all members shall have the privilege of participating in the discussions and presenting papers.
9. Every application for membership, whether as Fellow, Life Fellow, Honorary Fellow, or Associate Fellow, shall be endorsed by two Fellows in good standing, and be presented to the Executive Council through the Secretary, two months before the first

day of the annual meeting, and when recommended by the Executive Council shall be voted upon by ballot at the annual meeting; a list of the recommended names shall be sent to every member with the notification of the meeting; the nomination of Honorary Fellows shall be vested in the Executive Council.

10. A two-thirds vote in the affirmative of all the Fellows present shall be necessary to elect; fifteen Fellows at least being in attendance.

11. Every Fellow, on being elected, shall sign the Constitution and By-laws of the Association.

12. Fellows and Life Fellows shall pay to the Secretary before registration at the annual meeting, the fees or dues provided for in the By-laws of the Association, and shall not be entitled to vote on any question, or participate in the discussions or transactions of the Association before registration. Honorary and Associate Fellows shall be exempt from payment of fees or dues.

13. This Association reserves the right of punishing any member by reprimand, suspension, or expulsion for violation of its regulations, or the Code of Ethics, as provided in the By-laws.

#### OFFICERS.

14. The officers of this Association shall be, a President, two Vice-Presidents, a Secretary, a Treasurer, and six members of the Executive Council.

15. The nominations of all officers shall come before the Association in the report of the Committee on Nominations, at the business meeting, and the election shall be by ballot at that meeting, the result being determined by a majority vote of those present and voting.

16. The officers shall enter upon their several duties, as provided in the By-Laws, immediately before the adjournment of the meeting at which they are elected, and shall hold office for one year, or until others are appointed in their places.

17. Any vacancy occurring during the recess shall be filled temporarily by the President.

18. The officers of this Association, with the exception of the members of the Executive Council, shall be elected annually at the business meeting, and serve for one year.

19. Two members of Executive Council shall be elected annually at the business meeting, to serve for three years. Two shall retire by rotation each year.

**ANNUAL MEETING.**

20. The time and place of holding the annual meeting shall be determined by the Association each time before adjournment.

21. It shall continue for three days, unless otherwise ordered by a majority vote of the Association at any regular meeting.

**AMENDMENTS.**

22. This Constitution may be amended by a two-thirds vote of all the Fellows present and voting at an annual meeting, but not less than fifteen Fellows must be present; provided, that notice of the proposed amendment has been given in writing at the annual meeting next preceding, and handed to the Secretary; and provided further, that it shall have been printed in the notification of the meeting at which the vote is to be taken. All proposals to amend shall be referred to the Executive Council to examine and report upon, before action thereon by the Association.

23. This Association endorses, and shall be guided by the Code of Ethics of the American Medical Association.

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**BY-LAWS.**

**MEETINGS.**

1. In addition to the annual meeting of the Association as provided by the Constitution, special meetings may be called at any time, upon a requisition signed by ten Fellows being presented to the President, who shall determine the time and place of such meeting.

**QUORUM.**

2. The Fellows present shall constitute a quorum for the transaction of all business excepting the election of members, the disciplining of members, or action on proposed amendments to the

Constitution or By-laws, when not less than fifteen Fellows must be present.

THE PRESIDING OFFICER.

3. The President shall preside at all meetings, and perform such other duties as by usage appertain to his office.
4. The presiding officer shall be ex-officio Chairman of the Executive Council, but shall vote therein only in case of a tie.

VICE-PRESIDENTS.

5. The Vice-Presidents shall assist the President in the performance of his duties, and in his absence or at his request shall preside at all meetings, and perform such other duties as ordinarily pertain to the Chair. They shall preside in the order of seniority of election.
6. In case of the absence of the President and Vice-Presidents, the Association shall appoint a President pro tempore.

SECRETARY.

7. The Secretary shall give one month's notice of the meetings of the Association, to all members, with a list of candidates recommended for membership and programme of meeting ; shall receive all applications for membership, and make due inquiry concerning each, reporting to the Executive Council ; shall attend with the records and documents of the Association, and keep a record of all meetings of the Association, its Committees when requested, and of the Executive Council, and shall be ex-officio Clerk of the Council, but shall not be entitled to vote therein.

8. He shall keep a Standing Register of the Fellows.
9. He shall keep an Annual Register in which each member not in arrears shall enter his name before attending the annual meeting.
10. He shall receive all reports from all committees, and all papers immediately upon being read at the meetings and shall file them with the other Transactions, and shall read by title, or extract, all papers which the Executive Council decides shall be read in that manner.

11. He shall be the custodian of the seal, books, records, manuscripts, and all other property of the Association.

12. He shall supervise and conduct all correspondence of the Association, forwarding to each Fellow as soon after adjournment as practicable, a letter containing a list of officers, committees, Fellows elected, resignations, necrology, date and place of next meeting, and other pertinent matter, which letter shall be a notification to members of their election or appointment as officers, or members of committees ; he shall superintend the publication of the Transactions under the direction of the Executive Council, and their distribution to members entitled to receive them, and shall perform all the ordinary duties of his office.

13. He shall collect all moneys due from the members, and shall pay all accounts by cheque, taking proper vouchers therefor, drawing upon the Treasurer when necessary through order of the President countersigned by himself, shall hand the balance over to the Treasurer immediately upon adjournment, and shall bring in a properly classified annual report of business transactions since the last meeting, which, together with his books and vouchers, shall be examined by the Committee on Audit, and shall complete all business in his department arising during his year of office before handing over his documents to the Association.

TREASURER.

14. The Treasurer shall receive from the Secretary the balance on hand immediately upon adjournment of the annual meeting, shall be accountable for the safe keeping of all funds of the Association in his charge, pay such orders as may be drawn on him by the President, countersigned by the Secretary, shall present a report at the annual meeting, which, with his books and vouchers, shall be examined by the Committee on Audit, and when called upon by the Association shall hand over to his successor in office, or anyone appointed by the Association to receive them, all moneys, papers, books or other matter in his possession, which are claimed as belonging to it.

**EXECUTIVE COUNCIL.**

15. The Executive Council shall meet as often as the interests of the Association may require. The President, or any three members may call a meeting, and three members shall constitute a quorum.

16. It shall receive and consider proposals for membership, shall make due inquiry concerning the professional attainments and standing of each applicant for membership, and recommend to the Association for election such as are eligible ; the nomination of Honorary Fellows shall be vested in it.

17. It shall have control of the arrangements for the annual meetings, shall determine the order of the reading of papers, and whether they shall be read by title, extract, in extenso, or shall be rejected.

18. It shall watch the course of legislation likely to affect medicine or electricity, shall be the proper channel for legislation offered by any member, and shall report any new legislation affecting the profession at the annual meeting.

19. It shall direct the publication of all transactions, circulars and all matter connected with the Association, shall reserve the right of publication of all papers and reports presented, and of all transactions.

20. It shall examine and report upon any changes connected with the Constitution or By-laws it may think necessary. All proposed alterations or additions shall be referred to it.

21. It shall constitute a court of inquiry for the investigation of all charges against members, for offences involving law, ethics, or honor, and shall have the sole power of moving the reprimand, suspension, or expulsion of any member.

22. It shall have the sole power of moving the forfeiture of membership of any Fellow two years in arrears to the Association, or of any Fellow who, for three consecutive years, shall neither attend the meetings, nor present papers, nor offer to the Council a satisfactory explanation thereof.

23. It shall have the management of the affairs of the Association, subject to the action of the Association at the annual meetings.

(a) COMMITTEES—TEMPORARY.

24. Temporary Committees shall be appointed annually, shall enter upon their duties as soon as they are appointed, and continue until they are discharged, or their successors are chosen. The Chairman shall be designated by the President.

COMMITTEE ON NOMINATIONS.

25. The Committee on Nominations shall be elected by ballot on the second day of the annual meeting, it shall consist of at least two, and shall contain one member for every fifteen Fellows registered at the time the ballot is taken.

26. All nominations shall be in writing and shall be transmitted to the Committee through the Secretary, before 1 p.m. of the second day of meeting ; the Committee shall meet not later than the afternoon of the second day ; the various officers of the Association shall be selected from the list thus obtained. In case of no nomination being made for any particular office, the Committee shall make the nomination. The Committee will also receive suggestions as to the next time and place of meeting. Its report shall be presented at the business meeting.

COMMITTEE ON AUDIT.

27. The Committee on Audit shall be appointed by the President on the second day of the annual meeting ; it shall consist of two members, to whom the Secretary and Treasurer shall submit their financial books, annual statements and vouchers ; each item shall be compared with its corresponding voucher and the result submitted in their report to the Association at the business meeting.

COMMITTEE ON ARRANGEMENTS.

28. The Committee on Arrangements shall be appointed by the President as early as practicable and report on the first day of meeting,

29. Whenever possible and practicable it shall appoint a Sub-committee on Exhibits, which shall arrange for an exhibition of such instruments or other apparatus as may have a bearing on the

objects of the Association, the profits available from such exhibition shall be applied to the payment of the expenses of the Committee on Arrangements, and the balance, if any, shall be forwarded to the Secretary of the Association.

(b) COMMITTEES—STANDING.

30. Standing Committees to investigate Scientific Questions shall consist of three members to be appointed by the President.

31. The Committees will collate information and make careful tests as to the nature and efficiency of all instruments put on the market presented for tests in the class assigned to them, and make full reports of their investigations at the annual meeting, which shall be either typewritten on one side of foolscap paper, or legibly written on one side of ruled foolscap with margin; immediately upon being read at the meeting they shall be handed to the Secretary to be filed with the other transactions of the Association.

32. The following Standing Committees shall be appointed :

- (1) Standing Committee on Induction Coils and Alternators.
- (2) Standing Committee on Meters.
- (3) Standing Committee on Static Machines and Condensors.
- (4) Standing Committee on Constant Current Generators and Controllers.
- (5) Standing Committee on Electrodes.
- (6) Standing Committee on Electric-Light Apparatus for Diagnosis and Therapy, and the Roentgen X-Ray.

33. The President may appoint Special Committees to investigate Scientific Questions, to consist of three members, for one year.

34. Other committees, temporary or standing, which may be thought necessary, may be appointed by the President.

ORDER OF BUSINESS.

35. The Order of Business at the annual meetings of this Association shall be as follows, a quorum being present :

General Session at ten o'clock a.m. each day.

- (1) Reading of minutes of previous meeting.
- (2) Addresses of welcome and responses.
- (3) Reception of Honorary Fellows and Guests.

- (4) Communications.
- (5) Address of President.
- (6) Reports of Standing Committees.
- (7) Report of Committee on Arrangements.
- (8) Reading of Papers.
- (9) Resolutions.

36. At the final general session, all other business having been disposed of :—

- (1) Installation of President-Elect.
- (2) Adjournment.

37. An Executive Session from nine to ten a.m. each day :

- (1) Reading of Minutes.
- (2) Report of the Executive Council.
- (3) Communications.
- (4) Election of Members.
- (5) Appointment of Temporary Committees.
- (6) Reports of Committees.
- (7) Unfinished and Miscellaneous Business.
- (8) Resolutions and Notices of Motion.

38. Business Meeting at eight o'clock p.m. on the second day of meeting, unless otherwise ordered by vote of the Association :

- (1) Report of Committee on Audit.
- (2) Report of Secretary.
- (3) Report of Treasurer.
- (4) Report of Committee on Nominations.
- (5) Election of Officers.
- (6) Reports of Committees, not yet presented.
- (7) Miscellaneous Business.

39. None but Fellows of the Association shall be present at Executive Sessions and the Business Meeting.

**RULES.**

40. The Rules contained in "Robert's Rules of Order" shall govern this Association in all cases to which they are applicable, and in which they are not inconsistent with the By-laws of this Association.

## PAPERS.

41. No paper shall be read before this Association that has already been published, or that has been read before any other body.
42. Not more than twenty minutes shall be occupied in reading any paper before this Association.
43. All papers must be placed in the hands of the Secretary immediately after they have been read.
44. All papers read before this Association shall become the sole property of the Association.
45. The Executive Council may decline to publish any paper not handed to the Secretary complete before the adjournment of the annual meeting.
46. Only those papers which are of immediate importance and interest, or sufficiently practical and concise to make their reading advisable shall be read in extenso.
47. The Executive Council may direct that any paper shall be read by extract, in which case it shall be read by the Secretary, unless the writer nominates a reader.
48. The Executive Council may direct that in case of the absence of the writer, or for other cause, certain papers shall be read by title.
49. The Executive Council may give permission, to all members who desire to publish their papers or an abstract thereof previous to their publication in the Transactions, but not before they have been read at the meeting ; when such permission is given, it must be stated with the paper or abstract thereof that it has been read before this Association, and a copy of the paper must be handed to the Secretary before adjournment.
50. No paper read before the Association shall be published in any medical journal or pamphlet for circulation, as having been read before the Association without having received the endorsement of the Executive Council.
51. No speaker shall occupy the floor in any discussion for a longer period than five minutes, and no one shall have the privilege of speaking more than once on any question under consideration, except for explanation ; but on motion of the Associa-

tion an extension of time of five minutes may be allowed a speaker.

52. No person shall be permitted to occupy the time or engage the attention of the meeting, read papers or take part in their discussion, but members who have registered, and guests.

53. Guests shall be such members of the Medical Profession or Electrical Experts, in good standing, as the President may be pleased to invite to the meeting ; who shall be entitled to seats, and to present papers and take part in the discussions.

DECORUM.

54. No remarks reflecting on the personal or professional character of any Fellow shall be in order at any meeting.

55. All charges against members shall be made in writing, and given to the Secretary at the annual meeting, to be referred without debate to the Executive Council, whose decision shall be final.

ATTENDANCE.

56. Any Fellow who shall neither attend nor present a paper for three consecutive years may be dropped from membership.

FINANCE.

57. Each Fellow, on being elected a member of this Association, shall pay to the Secretary an initiation fee of ten dollars, which shall include his dues for the first year.

58. Each Fellow shall pay in advance to the Secretary the sum of five dollars annually thereafter, which shall constitute his annual dues.

59. Any Fellow neglecting to pay his dues for two years shall forfeit his membership.

60. Each Life Fellow shall, upon being elected, pay to the Secretary the sum of fifty dollars, and shall be exempt thereafter from all annual dues.

61. A contingent fund of one hundred dollars shall annually be placed at the disposal of the Secretary for current expenses, to be disbursed by him, and for which he shall present proper vouchers ; the Secretary shall immediately upon adjournment

draw upon the Treasurer for this amount by an order signed by the President.

62. No account shall be paid by the Secretary except on direction of the President; all accounts shall be paid by cheque of the Secretary.

**AMENDMENTS.**

63. Any By-law may be suspended, for that meeting only, by a two-thirds vote of the Fellows present and voting at any meeting; but shall be amended, only in the same manner as the Constitution, viz., by a two-thirds vote of all the Fellows present and voting at an annual meeting, not less than fifteen Fellows being present, provided, that notice of the proposed amendment has been given in writing at the annual meeting next preceding, and handed to the Secretary. And provided further, that it shall have been printed in the notification of the meeting at which the vote is to be taken.

64. All proposals to amend shall be referred to the Executive Council to examine and report thereon before action by the Association.

MINUTES OF THE PROCEEDINGS  
AT THE  
EIGHTH ANNUAL MEETING  
OF THE  
AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

HELD IN THE ROOMS OF THE SOCIETY OF NATURAL SCIENCES, PUBLIC LIBRARY  
BUILDING, BUFFALO, N. Y., SEPTEMBER 13TH, 14TH AND 15TH, 1898.

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CHARLES REA DICKSON, M.D., of Toronto, President.

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**FIRST DAY—Tuesday, September 13th.**

*Morning—Executive Session.*—The meeting was called to order by the President, Dr. Charles Rea Dickson, of Toronto, at 10.15 a.m.

Divine blessing was invoked by the Rev. Orrin P. Gifford, of Buffalo, as follows :

“ Infinite God, in whom we live and move and have our being, help us to understand our environment and adjust ours to it. We beseech Thee to open our eyes that we may behold wondrous things out of Thy law. We beseech Thee to send the spirit of truth on this Association. Help us to live truth as fast as we learn it. Bless us in our ministry to men, for Thy Name’s sake. Amen.”

The President then declared the Eighth Annual Meeting opened.

On motion of Dr. G. Betton Massey, of Philadelphia, Pa., the minutes of the previous meeting were taken as read.

The report of the Executive Council was presented by the Secretary, Dr. John Gerin, of Auburn, N.Y. On motion of Dr. William T. Bishop, of Harrisburg, Pa., the reading of the report was postponed until the next Executive Session.

On motion, the election of members was deferred until the next Executive Session.

Dr. William T. Bishop moved that the privileges of the floor be extended to all the members of the regular medical profession in Buffalo at this time, whether resident or not. Seconded and carried unanimously.

The Executive Session then adjourned.

*General Session.*—The Association went into General Session at 10.30 a.m. The President introduced Dr. Conrad Diehl, Mayor of Buffalo, who delivered the address of welcome.

#### ADDRESS OF WELCOME.

*Mr. President, Ladies and Gentlemen,*—It gives me an especial pleasure, being myself a physician, to tender to you the freedom of the city. Knowing the advance that has been made in electricity since my beginning, when I thought I was treating patients well with electricity obtained from the old Kidder battery, I am certain that there is a great future for this department of medicine, and I wish I had the faculty of expressing more fully my thoughts on this subject.

The local profession here is devoting considerable time to the study of this branch of medicine, and I am sure they will make your stay here, as far as the social part is concerned, a happy one. Those of you who have not spent much time in our city before, will be much interested, I think, in examining the electrical machinery in this vicinity. The cars in our streets are run by the power obtained from Niagara Falls. I hope you may obtain permission to see the enormous storage battery used by the railroad companies.

Wishing you great success in your undertakings, I again extend to you the freedom and hospitality of the city.

THE PRESIDENT—I shall introduce to you now one who really needs no introduction, one who has always taken a great deal of interest in the work of this Association, Dr. Francis B. Bishop, of Washington, D.C., who will reply to the address of welcome on behalf of this Association.

RESPONSE TO THE ADDRESS OF WELCOME BY DR. FRANCIS B.  
BISHOP.

*Mr. President, Ladies and Gentlemen,—*We have all listened with intense interest to the most excellent address of his Honor, the Mayor of Buffalo. It becomes my very agreeable duty to tender to his Honor the thanks of this Association for his very hearty welcome to this city. When first called upon, sir, to respond to his Honor, I felt my utter inability to do justice to this occasion. I was reminded of a cartoon which I saw in a paper some time ago. It represented an old negro being examined by a physician on board of a man-of-war. After looking him over carefully the doctor said : "My man, I can't find anything the matter with you ; you seem to be a strong, healthy-looking fellow ; what's the matter with you any way ?" "Well, boss," said the darkey, "I eats good, I sleeps good and I drinks good, but when I sees a job o' work I is tooken all over with a tremblin'." (Laughter.) I feel just that way now. As I listened to the hearty words of welcome expressed by his Honor the Mayor, I felt glad that I was a member of the medical profession and that I was a member of this scientific body, which stands so high in the estimation of a progressive people.

We feel deeply honored, Mr. Mayor, by your presence. You have touched a responsive chord in every heart. It may be pleasant to you to know that this Association is not undeserving of honor. A reference to our printed Transactions will show a portion of the mammoth work that has been accomplished in the few short years of its existence. The names of Dolbear, Herdman, Morton, Houston, Cleaves, Rockwell, Dickson, Newman and many others stand prominently before the scientific world, and their works have stood out as a beacon in a dark and unexplored wilderness. The eyes of the scientific world are on us to-day, but I am sorry to say that there are still many in our noble profession who condemn everything connected with electro-therapeutics, or else condemn us with very faint praise. But the time is coming when this Association will stand with reference to electro-therapeutics as the American Medical Association stands to the general profession of America.

Mr. President, I would suggest that his Honor be requested to furnish us with a copy of his address, that it may be entered in our Transactions.

There is much more that I would like to say, but the time is short, and I can imagine you saying, when will he stop? And this reminds me of an anecdote told by Poke Miller, the negro delineator. He was standing in a little town in North Carolina talking to a ventriloquist, when along came an old nigger. Just as he got opposite the two gentlemen, the ventriloquist made the turtle, which the nigger was carrying, say, "Whar you goin' to drap me?" The old darkey looked all around and said, "What's that you say?" "Whar ye goin' to drap me?" said the voice again. "I'm goin' to drap yer right hear," said the nigger; and he did drop him right there, and ran. In a similar manner I am going to drop this subject right here. (Laughter and applause.)

The President announced that delegates had been appointed from several medical societies, as follows: Medical Association of Central New York, Dr. William C. Krauss, the President; Medical Society of the State of New York, also Medical Society of the County of Erie, Dr. Lucien Howe, President of the latter; Buffalo Academy of Medicine, Dr. Floyd S. Crego; Ontario Medical Association, Dr. G. Sterling Ryerson, Toronto, Canada.

The President introduced Dr. Henry McClure, of Norwich, England, an Honorary Fellow, and requested him to address the Association.

DR. MCCLURE—*Mr. President, Ladies and Gentlemen*,—I must apologize for being late this morning, owing to the fatigue of long travelling. I thank you very much for the very kind way in which the President has spoken of me. I have looked forward for a long time to the pleasure of being here. When I am troubled with electricity I always look back to your proceedings and find help there. I think that during the last year there have been greater strides, especially in the theoretical department of electro-therapy, than ever before, and I have come here in the hope of receiving the information for which I have been seeking. I thank you for the opportunity given me to speak.

Dr. Thomas C. Holland, of Hot Springs, Ark., was then presented to the Association. He said:

*Mr. President, Ladies and Gentlemen,—*I arrived here this morning at an early hour and heard there was a medical convention in town. I have been somewhat interested in electricity for a number of years, and I have therefore dropped in on you this morning to see what work you are doing. I shall be compelled to leave town before long, but I am very anxious to be allowed to subscribe to your volume of Transactions.

**THE PRESIDENT**—We have with us an old and honored member, one who has stood long in the front ranks of the profession, and whose name will go down to posterity as an honored name. I take great pleasure in asking Dr. A. D. Rockwell, of New York, the “old war-horse,” to say a few words.

**DR. A. D. ROCKWELL**—*Mr. President,—*I have nothing very special to say, although I am very thankful to you for the kind words you have spoken. I have done what I could in the past, and propose to work on in my own way. I think we should not be too enthusiastic, but should weigh carefully everything which is said and done in regard to electricity. Progress in this department is too often hindered, I think, by unbounded and unwarranted praise. No one appreciates its value more than I do, but we must find its limitations and must not be afraid to state our opinions regarding what it can and cannot do. This Association is fortunately composed of conservative men, and they will, I am sure, do everything possible to raise the standard of electro-therapeutics.

Notes were read from Drs. Apostoli and Gautier, of Paris; Felice La Torre, of Rome; Bergonié, of Bordeaux; Inglis Parsons, of England, and others, expressing regret at not being present and wishing success to the meeting.

Report of the Committee on Arrangements—Dr. Ernest Wende, of Buffalo, N.Y., Chairman, presented this report :

It gives me great pleasure to extend to you, on behalf of the Local Committee of Arrangements, a most cordial welcome to our city. You have assembled here to hold the eighth annual meeting of your organization, and I assure you that our city considers itself honored by your presence. We sincerely hope that your meeting will be a fruitful one, and that the results may be beneficial to you as a body, as well as to the community at large.

There will be a Tally-ho ride about the city, affording an opportunity to see how beautiful Buffalo is. It will leave this building promptly at 2.30 p.m. to-day, and at 9 a.m. and 2.30 p.m. to-morrow. We have also secured the privilege of giving you a bird's-eye view of the city from our highest building, the Guarantee building.

The Society of Natural Science has kindly opened its rooms to the Association, and you are also invited to visit the collections of the Historical Society and the Gallery of Fine Arts.

This evening a public reception will be held in the large amphitheatre of the University of Buffalo, and addresses will be delivered by the Rev. Orrin P. Gifford, Dr. Henry R. Hopkins and others.

Dr. Lucien Howe has kindly invited all the members to attend the reception at his house to-morrow evening, to meet the medical faculty of the University and the officers of medical societies of Buffalo.

On Thursday afternoon there will be an excursion on the Niagara river, on the east side up to the site of the Pan-American Exposition. We will then return to the Island Club on Grand Island, where dinner will be served.

I hope these arrangements will make your stay here pleasant. It has been proposed by the President that a party be gotten up for a bicycle ride. Buffalo has a very extensive system of asphalt pavements, and it is not improbable that you would find such a ride very enjoyable.

THE PRESIDENT—I shall now ask Dr. Lucien Howe, of Buffalo, to say a few words to us.

Dr. LUCIEN HOWE—I feel very much honored to be asked to say even a word, although it is entirely unexpected. I was not in at the commencement of your exercises, but I am sure of the kindly words of welcome that have been expressed by the members of the local profession. That is all I care to say at the present time.

Report of the Committee on Niagara Falls Excursion—Dr. Robert Newman, of New York, Chairman, presented this report.

Special hotel and other arrangements have been made for members and their friends desiring to visit Niagara Falls; baggage

should be expressed from Hotel Iroquois at Buffalo to International Hotel at Niagara Falls before leaving for the Grand Island trip on Thursday afternoon. On returning to the city, trolley cars may be taken two blocks from the wharf direct to the hotel door at the Falls. On Friday morning a round trip will be taken, which takes three hours, by the electric roads on both Canadian and American sides of Niagara River. After lunch the power-house of the Niagara Falls' Power Company and other points of great interest will be visited. Tickets for the round trip, including admission to the Observation Tower, \$1.00, to be obtained from Dr. Newman, who will also issue tickets entitling to reduced hotel rates at Niagara Falls, N.Y. Those unable to remain until Friday may take the trip any day during the week.

Dr. William T. Bishop moved that the association proceed with the reading of the reports of standing committees. Carried.

Report of the Standing Committee on Meters—By Dr. Margaret A. Cleaves, of New York, Chairman. On motion the report was adopted and the committee requested to continue its labors. Dr. Cleaves announced that the committee was not willing to continue its work, but desired the appointment of a new committee.

Report of the Standing Committee on Constant Current Generators and Controllers—Dr. Robert Newman, of New York, in the absence of Dr. Wm. J. Herdman, of Ann Arbor, Mich., Chairman, read a supplementary report. On motion of Dr. William T. Bishop the report was adopted.

Report of the Committee on Electrodes—Dr. Charles R. Dickson, of Toronto, Chairman, regretted that his duties as President had interfered with his work on this committee, and as another member was also Secretary of the Association, and a portion of the work assigned to a third member had not been prepared, little had been accomplished. All three members of the committee had met in New York, in January, 1898, and some useful work had been done.

Report of the Committee on Electric Light Apparatus for Diagnosis and Therapy, and the Roentgen X-ray—Mr. John J. Carty, E.E., of New York, Chairman, reported progress.

Report of the Committee on Cataphoresis—Dr. G. Betton Massey, of Philadelphia, Pa., reported progress.

Papers were then read as follows:

"Phlebitis, a Clinical Study," by Dr. Margaret A. Cleaves, of New York.

"The Diagnostic and Therapeutic Relations of Electricity to the Diseases of the Central Nervous System," by Dr. A. D. Rockwell, of New York. Discussed by Drs. Massey, Newman, W. T. Bishop, F. B. Bishop, Cleaves and McClure. Discussion closed by Dr. Rockwell.

The Association adjourned at 12.30 p.m.

*Afternoon Session.*—The Association was called to order by the President at 2 p.m.

"New Uses of the Undulatory Current in Gynecology," by Dr. Georges Apostoli, of Paris, France. Read by Dr. G. Betton Massey. Discussed by Dr. Massey.

"Electricity in the Treatment of Uterine Fibro-myomata," by Dr. Felice La Torre, of Rome, Italy. Read by Dr. John Gerin, Secretary.

"Electricity Employed in Gynecology," by Drs. Georges Gautier and J. Larat, of Paris, France. Read by Dr. Charles R. Dickson, President.

"The Treatment of Uterine Fibroids by Small Currents Administered Percutaneously," by Dr. Richard J. Nunn, of Savannah, Ga. Discussed by Drs. Massey and McClure, and discussion closed by Dr. Nunn.

"Menorrhagia and its Treatment by Weak Galvanic Currents with Intra-Uterine Positive Silver Electrode," by Dr. Adelstan de Martigny, of Montreal, Canada. Read by Dr. W. H. White.

The Association adjourned at 4.20 p.m.

*Evening Session.*—A public reception was held in Alumni Hall, University of Buffalo, at 8.30 p.m.

Addressess were delivered by the Chairman, Dr. Charles R. Dickson, President; Dr. Henry R. Hopkins, of Buffalo; Dr. Robt. Newman, of New York; the Rev. Orrin P. Gifford, of Buffalo, and Dr. G. Sterling Ryerson, of Toronto.

The Association adjourned at 10 p.m.

**SECOND DAY—Wednesday, September 14th.**

*Morning—Executive Session.*—The Association was called to order by the President at 9 a.m.

The report of the Executive Council was read by the Secretary.

Candidates for Membership.—The following were recommended for membership by the Executive Council:

As Fellows—Dr. Jean F. Chauveau, jun., New York; Dr. F. A. Coope, Oil City, Pa.; Dr. Raymond M. Evarts, Silver Creek, N.Y.; Dr. Charles O. Files, Portland, Me.; Dr. C. H. Hughes, St. Louis, Mo.; Dr. John A. Lichy, Clifton Springs, N.Y.; Dr. Adelstan de Martigny, Montreal, Canada; Dr. Stephen C. Powell, Newport, R.I.; Dr. Robert Reyburn, Washington, D.C.; and as Associate Fellow, Mr. Burton Kenraide, Boston, Mass.

Dr. John Gerin moved the admission to membership of the candidates whose names had just been read. Seconded. Carried.

On motion, the Secretary was instructed to cast the ballot of the Association for the election of these candidates, which being done, they were declared duly elected members of the Association.

Revision of the Constitution.—Dr. William T. Bishop said that every member had received a copy of the Report on Revision of the Constitution, and he therefore moved the adoption of these revisions.

Dr. R. J. Nunn asked if the question of the standing of those engaged in the sale of medical instruments had been settled in this revision.

The President ruled that dealers, etc., had been provided for by the associate membership.

Dr. Margaret A. Cleaves said that there was not one among the associate or honorary fellows engaged in the manufacture or sale of such instruments, unless we include possibly a coil which Mr. Tesla had in course of construction. She would not personally place Mr. Tesla in that category were it not for private information regarding this coil.

Dr. Robert Newman said that Mr. Tesla had told him that he invented the instruments but was not engaged in their manufacture.

The President asked Mr. Carty for his opinion on this subject.

Mr. John J. Carty said that at the earlier meetings of this Association Dr. Newman had expressed a desire for the presence of certain electrical experts to instruct the physicians on certain points. He had himself been elected a member, and had kept more or less in touch with the Association, not only because of the pleasant social intercourse with the other members, but because he felt that he owed a little to the medical profession in keeping them properly in line from the electrical engineer's point of view. Looking over the list of associate and honorary members, he would say that he thought they all felt they were bound by the ethics which govern physicians.

The question was as to the admission to the Association of manufacturers. The Society should be closely in touch with manufacturers, and the experts of manufacturers might be admitted, but not the firms employing them.

Dr. William T. Bishop thought Mr. Carty had expressed what is provided for in the amendments to the Constitution. As every individual case must be acted upon, there should be no objection to the adoption of the proposed amendments as printed and presented to the members.

Dr. William T. Bishop then moved that the report of the Executive Council on revision be adopted, and that the revisions stand, with the exception of the correction of any possible typographical errors. Seconded, and carried unanimously.

Committee on Nominations.—Dr. William T. Bishop moved that a Committee on Nominations, consisting of three, be appointed by the President, and that it be instructed to report at the business meeting this evening. Seconded, and carried unanimously.

The President appointed the following a Committee on Nomination: Dr. Emil Heuel, of New York; Dr. H. H. Hahn, of Youngstown, Ohio, and Dr. W. H. White, of Boston.

The Secretary's report was then read by Dr. John Gerin.

The resignations of Drs. Daniel B. D. Beaver, of Reading, Pa.; Lucy Hall-Brown, of Brooklyn, N.Y.; Landon Carter Gray, of New York; Max Einhorn, of New York; George J. Engelmann, of Boston, Mass.; Henry W. Gillette, of Newport, R.I.; Eliza M. Mosher, of Ann Arbor, Mich., and S. H. Weeks, of Portland, Me., were read and accepted.

The Treasurer's report was read by the Secretary, Dr. John Gerin.

On motion of Dr. William T. Bishop, the reports of Secretary and of Treasurer were accepted and referred to a Committee on Audit, to be appointed by the President. The President appointed Dr. H. H. Hahn and Dr. F. B. Bishop a Committee on Audit.

The Executive Session then adjourned.

*General Session.*—The Association went into General Session at 10 a.m.

Dr. Wende announced for the Committee on Arrangements that an invitation to visit the power-house and storage batteries of the Buffalo Railway Company—the largest storage battery in existence—had been sent by Superintendent Danforth at the request of Mayor Diehl, and that special cars would be in waiting at the library building at an hour to be appointed by the President, to convey the members to the power-house.

The invitation was accepted with thanks, and the President selected 4.30 this afternoon as the time at which the visit would be paid, and announced that members leaving at an earlier hour on the Tally-ho ride would meet the balance of the members at the power-house before returning to the hotel.

“On the Use of Cataphoresis in Certain Forms of Conjunctival Inflammation,” by Dr. Lucien Howe, of Buffalo, N.Y. Discussed by Drs. Newman, Nunn, Cleaves, Rockwell and Massey. Discussion closed by Dr. Howe.

“Electricity in Deafness and Stricture of the Eustachian Tube,” by Dr. Robert Newman, of New York, N.Y. Discussed by Drs. Howe, Rockwell, Cleaves and Massey. Discussion closed by Dr. Newman.

Dr. Lucien Howe presented a message of regret from Dr. John O. Roe, of Rochester, N.Y., who was ill and out of town, and therefore unable to present his paper on “The Use of Electricity in Diseases of the Nose and Throat.”

“Electricity in Acne Vulgaris and Acne Rosacea,” by Dr. Grover W. Wende, of Buffalo, N.Y. Discussed by Drs. Massey, Cleaves, Newman, Heuel and Alfred Livingston. Discussion closed by Dr. Wende.

The President announced that "A Case of Lightning-Stroke Without Serious Consequences," by Dr. William C. Krauss, of Buffalo, N.Y., would not be presented, as he regretted to say that Dr. Krauss had been ill and was still under a physician's care; he introduced Dr. G. Sterling Ryerson, D.S.G., of Toronto, delegate from Ontario Medical Association.

"Cases of Lightning-Stroke Causing Diseases of the Eye," by Dr. G. Sterling Ryerson, D.S.G., of Toronto, Canada.

"High Tension Currents in the Treatment of Neuritis," by Dr. Francis B. Bishop, of Washington, D.C. Discussed by Drs. Massey, Cleaves and Nunn. Discussion closed by Dr. Bishop.

"Electricity in the Treatment of Goitre," by Dr. Charles R. Dickson, of Toronto, Canada.

The Association adjourned at 1 p.m.

*Afternoon Session.*—The meeting was called to order by the President at 2 p.m.

President's Address, "Aims and Claims," by Dr. Charles R. Dickson, of Toronto, Canada.

Dr. William T. Bishop moved that the suggestions contained in the President's address be referred to the Executive Council for report at the next meeting. Seconded, and carried unanimously.

#### TEN MINUTE TALKS UPON ELECTRO-THERAPY.

These were introduced by the statement of the President that their object was to present in a condensed and practical form, free from technicalities, some of the salient points connected with electro-therapy, which may be of interest to the general practitioner.

1. "The Action of Electricity Upon Tissue Metabolism," by Dr. Wm. J. Herdman, of Ann Arbor, Mich. Read by title.

2. "The Functional Neuroses, with Special Reference to Neurasthenia; Their Pathology and Treatment," by Dr. A. D. Rockwell, of New York, N.Y.

3. "The Galvanic Current in Gynecology," by Dr. G. Betton Massey, of Philadelphia, Pa. Discussed by Dr. F. B. Bishop. Discussion closed by Dr. Massey.

4. "Combined Use of Medicinal and Electrical Treatment in Some Affections of the Eye," by Dr. G. Herbert Burnham, of Toronto, Canada. Read by title.
5. "Electricity in Genito-Urinary Diseases," by Dr. Robert Newman, of New York, N.Y.
6. "Orthopedic Uses of Electricity," by Dr. Louis A. Weigel, of Rochester, N.Y.
7. "The New Cataphoric Treatment of Cancer," by Dr. G. Betton Massey, of Philadelphia, Pa. Discussed by Dr. Cleaves. Discussion closed by Dr. Massey.
8. "Some Surgical Uses of Electricity," by Dr. Charles R. Dickson, of Toronto, Canada. Discussed by Drs. Massey and Nunn. Discussion closed by Dr. Dickson.

The Association adjourned at 4.30 p.m. and proceeded by private cars, accompanied by Mayor Diehl, to visit the power-house and storage batteries of the Buffalo Railway.

*Evening Session—Business Meeting.*—The Association was called to order by the President at 8.15 p.m., and the report of the Committee on Nominations called for.

Dr. Emil Heuel reported that for the office of President two names had been presented : Dr. A. D. Rockwell, of New York, N.Y., and Dr. Francis B. Bishop, of Washington, D.C. At the request of Dr. Rockwell his name was withdrawn. The report then read as follows :

<i>President,</i>	- - -	Dr. Francis B. Bishop, of Washington, D.C.
<i>1st Vice-President,</i>	-	Dr. Ernest Wende, of Buffalo, N.Y.
<i>2nd Vice-President,</i>	-	Dr. Walter H. White, of Boston, Mass.
<i>Secretary,</i>	- - -	Dr. John Gerin, of Auburn, N.Y.
<i>Treasurer,</i>	- - -	Dr. Richard J. Nunn, of Savannah, Ga.

*Executive Council.*

<b>3 years,</b>	-	Dr. Robert Newman, of New York, N.Y.
<b>3 "</b>	-	Dr. G. Betton Massey, of Philadelphia, Pa.
<b>2 "</b>	-	Dr. A. D. Rockwell, of New York, N.Y.
<b>2 "</b>	-	Dr. William J. Morton, of New York, N.Y.
<b>1 year,</b>	-	Dr. Charles Rea Dickson, of Toronto, Canada.
<b>1 "</b>	-	Dr. Frederick Schavoir, of Stamford, Conn.

Place of meeting, Washington, D.C.

On motion of Dr. William T. Bishop the report was adopted and the Secretary directed to cast the ballot of the Association for the officers named, and they were declared elected unanimously.

Dr. Robert Newman moved that the Ninth Annual Meeting be held on September 19th, 20th and 21st, 1899, at Washington, D.C. Carried.

Dr. John Gerin gave notice of motion to amend Constitution, Section 20, relative to the place of meeting, to make the permanent place of meeting New York City.

Dues for the Newly Elected Members.—Dr. Newman asked for a ruling of the Chair regarding when the revised Constitution went into effect, in order to determine the amount of dues for the newly-elected members.

The President ruled that the revised Constitution went into force this morning, and that the members' dues must be in accordance with that view.

Dr. William T. Bishop then moved that the Secretary be instructed to collect the fees and dues from the members elected at this session in accordance with the revised constitution. Carried.

Dr. John Gerin moved that the Transactions be hereafter furnished to members without cost. Seconded by Dr. G. Betton Massey.

Dr. William T. Bishop moved as an amendment that the Transactions be furnished without cost, provided the Council finds that the funds of the Association warrant such action. Seconded, and the motion as amended carried.

Dr. William T. Bishop moved that fifty dollars be appropriated, not as compensation, but as a recognition of the services of the Secretary for the last year, and that the thanks of the Association be tendered him. Seconded by Dr. R. J. Nunn, and carried unanimously.

Dr. John Gerin said that the work had been done by him without any thought of compensation, and it had been a pleasure to do it. He thought, however, sufficient remuneration should be given the Secretary to allow of his hiring necessary outside assistance. He then expressed his thanks for the action of the Association.

Dr. William T. Bishop moved that Dr. Lucien Howe be requested to present at the next meeting of the Association a con-

tinuation and elaboration of the paper presented this morning. Seconded by Dr. G. Betton Massey, and carried.

On motion the Association adjourned at 9.15 p.m. to attend the reception at the residence of Dr. Lucien Howe.

**THIRD DAY—Thursday, September 15th.**

*Morning—Executive Session.*—The Association was called to order by the President at 9.35 a.m.

Thanks to the President—Dr. John Gerin moved a vote of thanks to the retiring President for the admirable manner in which the proceedings had been conducted.

Dr. Robert Newman moved as an amendment that the vote of thanks should be made to include the Secretary.

Dr. Francis B. Bishop moved as a further amendment that the thanks of the Association be extended to Dr. Robert Newman also.

Dr. G. Betton Massey heartily seconded this motion with a few feeling words.

Dr. William T. Bishop put the motion, as amended, and it was carried unanimously by a rising vote.

Dr. William T. Bishop moved that the Association extend, by a rising vote, its hearty thanks to Dr. Ernest Wende and his associates in Buffalo, who had done so much to make this meeting a success. Carried.

Dr. John Gerin moved a vote of thanks to Dr. Lucien Howe for his hospitality, also to the Mayor of the city, Dr. Conrad Diehl; to the Buffalo Railway Company, the University of Buffalo, the Society of Natural Science, Historical Society, Academy of Fine Arts, the press, particularly the representative of the *Buffalo-Commercial*, not only for the admirable accounts of the meeting, but also for publishing much preliminary news of the Association. Seconded and carried.

“Education in Electro-Therapeutics”—Dr. William T. Bishop moved, seconded by Dr. Robert Newman, “That the American Electro-Therapeutic Association would respectfully urge upon colleges and all teaching medical institutions the necessity of establishing chairs for the teaching of electro-therapeutics; and if this be not at once practicable, that more time be devoted to the teach-

ing of this important branch of therapeutics; and further, that this matter be urged upon the attention of the Association of Medical Colleges." Carried.

Dr. William T. Bishop moved that the Association tender its congratulations to the University of Buffalo for the advanced position taken by the latter regarding education in electro-therapeutics. Seconded and carried.

**Election of New Members**—Dr. Gerin moved that the rules be temporarily suspended, and that Dr. Alfred Livingston, of Jamestown, N.Y., and Dr. Lucien Howe, of Buffalo, be admitted this morning to membership in the Association as fellows. Seconded and carried unanimously.

The Secretary then, being instructed by the Association, cast the ballot of the Association for these members, and they were declared duly elected.

**Report of Committee on Audit**—Dr. F. B. Bishop reported that the committee had examined the accounts and vouchers of the Secretary and Treasurer, and had found the same to be correct. The report of the Secretary and of the Treasurer were on motion adopted.

On motion the executive session adjourned at 10.05 a.m., and the Association went into General Session.

**General Session.**—Dr. R. J. Nunn moved that, owing to the lack of time at the disposal of the Association, "The Alternating Current," by Drs. Georges Gautier and J. Larat, of Paris, France, be read by title. Seconded and carried.

Dr. G. Betton Massey moved that "Hot Air and Electric-Light Baths for Medical Use," by Drs. Gautier and Larat, be read by title. Carried.

Dr. R. J. Nunn moved that, all other foreign papers not yet read be read by title, viz.: "The Effect of High Tension Discharges on Bacteria," by Drs. J. Inglis Parsons and C. Slater, of London, England; "Report on the Action of X-Rays upon Tuberculosis," by Drs. J. Bergonié, of Bordeaux, and Teissier, of Paris, France; "Two Years' Practice with the Roentgen Rays," by Drs. Georges Gautier and J. Larat, of Paris, France. Seconded and carried.

"Alternating Dynamo Currents," by Dr. Francis B. Bishop. Discussed by Dr. Massey. Discussion closed by Dr. Bishop.

"The Electric Arc Bath—A Preliminary Report," by Dr. Margaret A. Cleaves, of New York, N.Y. Discussed by Dr. Nunn, Mr. Carty, Drs. F. B. Bishop and Massey. Discussion closed by Dr. Cleaves.

"The Electric-Light Bath," by Dr. J. H. Kellogg, of Battle Creek, Mich. Read by title.

"Some Suggestions on the Possibilities of Cataphoresis," by Mr. John J. Carty, E.E., of New York, N.Y. Discussed by Drs. Newman and Massey.

"High Frequency Oscillators for Electro-Therapeutic and Other Purposes," by Mr. Nikola Tesla, E.E., of New York, N.Y. Read by Dr. W. H. White.

Dr. William T. Bishop moved that a vote of thanks be tendered Mr. Nikola Tesla and the other honorary members for their valued contributions to this meeting. Seconded by Dr. Robert Newman, and carried unanimously.

The PRESIDENT—We have now completed our programme, but there is one act yet remaining. My term as President has come to an end, and I assure you I am deeply gratified with the reception that has been accorded to me, and greatly pleased with all that has been done by the members and others. I thank you all most sincerely for the uniform kindness and courtesy extended to me during my term of office. It now remains for me to resign this office gracefully and bid my successor Godspeed. I shall ask Dr. Newman and Dr. Nunn—both old and revered friends—to conduct the President-elect, Dr. Francis B. Bishop, of Washington, D.C., to the chair.

Dr. Bishop was duly conducted to the chair.

The PRESIDENT—I now transmit the gavel of the Association to Dr. Bishop, at the same time expressing the hope that you will be as kind to him as you have been to me. Dr. Bishop, I take great pleasure in handing you the gavel of the American Electro-Therapeutic Association.

Dr. FRANCIS B. BISHOP—*Ladies and Gentlemen*,—It is only fitting that I should make a few remarks in recognition of your kindness, and of the honor which you have conferred upon me in making me the chief officer of the American Electro-Therapeutic Association. I fully appreciate the difficulties to be met. In the

first place, I am succeeding one of the best men under the canopy of heaven ; I am succeeding a man who has given more time to insure the success of the meeting than any man who has preceded him, according to my knowledge. Dr. Dickson is something like "good old whisky"—the more you know him the better you like him, and after awhile you get into "the Dickson habit." That has been clearly demonstrated here by the easy manner in which this meeting has been conducted, with so little friction and at the same time with a creditable attendance from the general profession, the greatest honor we can expect.

I thank you for the honor conferred upon me. It was certainly not conferred upon me because of any great scientific attainment, or any great work that I have accomplished. There is only one reason for it that I can find, and that is your unselfishness and personal friendship. I can assure you it is appreciated to the fullest extent, and reciprocated. I beg every member of the Association to lend his or her aid, as far as possible. I wish every member of the Association would have a paper for presentation at the next meeting in Washington. This I consider to be the duty of each member, as our membership is small, and the object of the Association is the dissemination of electro-therapeutic knowledge to the general practitioner. There is none who has any experience whatever in the use of electricity but has also some rich experience each year, which, if contributed at our meeting, would add to the value of our Transactions, and aid others laboring in the same field, but of less experience.

I will not detain you longer, except to declare the Eighth Annual Meeting of the American Electro-Therapeutic Association adjourned to meet in the city of Washington, D.C., on Tuesday, September 19th, 1899.

The Association adjourned at 12 a.m.

JOHN GERIN, M.D., *Secretary.*

At 2.30 p.m. the members of the Association, as guests of the Committee on Arrangements, embarked on the steam yacht Huntress on an excursion down the Niagara River to Navy and Buckhorn Islands and the site of the Pan-American Exposition, thence to the Island Club on Grand Island, where a reception was held,

followed by a dinner. On returning to the city the members left for Niagara Falls, N.Y.

Friday, September 16th, was spent in a semi-official manner, sight-seeing, under the direction of ex-President Dickson. In the morning, after obtaining the view from the top of the Steel Observation Tower, 300 feet high, the members proceeded by the Niagara Falls Park and River Railroad over the new upper arch-bridge—the longest steel arch-bridge in the world—first to Chippewa, Ontario, passing through Queen Victoria Park, the Dufferin Islands and the battlefield of Chippewa Creek, viewing *en route* the American and Canadian Falls, and rapids above Falls; then past the suspension and cantilever bridges, and across the Whirlpool Ravine, viewing the whirlpool 250 feet below, also the rapids, gorge and river, passing General Brock's monument, through the battlefield of Queenston Heights—about 350 feet above the river—down a mile and a half of a five feet in a hundred grade, to Queenston, and crossing the river by ferry to Lewiston, N.Y. The return trip to Niagara Falls was made by the Niagara and Lewiston Railway, the gorge route, which is about twenty feet above the river.

In the afternoon the members went out to the power-house of Niagara Falls Power Company, and were conducted over the station by the president and chief engineer, Coleman Sellars, E.D., who made the visit one of great interest and most instructive. On returning to the International hotel a meeting was held at which Dr. C. R. Dickson was requested to express to Dr. Coleman Sellars the thanks of the Association for his great kindness and courtesy.

An opportunity was then afforded to visit power station No. 2 of the Niagara Falls Hydraulic Power and Manufacturing Company, the Paper Mills, New York State Reservation Park, Prospect Park, Goat Island, Luna Island, and Three Sisters Islands, and many other points of interest in the vicinity; a trip was taken on the Maid of the Mist for a closer and farewell view of the Falls, after which the majority of the members left for their respective homes.

The exhibition of electrical apparatus for diagnostic, therapeutic and radiographic purposes was held in the lecture hall, Society of Natural Sciences, adjoining the rooms in which the Association met, Thos. B. Carpenter, M.D., of Buffalo, being Chairman of the Committee on Exhibits.

The following manufacturers exhibited : Van Houten & Ten Broeck, New York ; Chloride of Silver Dry Cell Battery Company, Baltimore, Md.; Jerome Kidder Manufacturing Company, New York ; Edison Manufacturing Company, New York ; Waite & Bartlett Manufacturing Company, New York ; Dow Electric Assistant Company, Boston, Mass.; The American Electro-neuro-tone Company, Niagara Falls, N.Y.; The Standard Cold Electric Lamp Company, Washington, D.C.; The Spenser Lens Company, Buffalo, N.Y.; The Detwiller Biddle Company, Buffalo, N.Y.; W. J. Shields & Company; New Wilmington, Pa.; Rochester Fluorometer Company, Rochester, N.Y.

JOHN GERIN, M.D., *Secretary.*

## The President's Address—Aims and Claims.

By CHARLES R. DICKSON, M.D., Toronto, Canada.

In view of the number and variety of papers with which we have to deal at this the eighth annual meeting of the American Electro-Therapeutic Association, I hesitate to inflict upon you a lengthy address ; and, were it not for precedent, doubt if I should address you in any formal manner whatever ; but on this, the first visit of our Association to Buffalo, I feel that, in justice to ourselves, I must tell our friends who we are and why we are here.

For several years past the thoughts of those who are interested in the varied branches of this wondrous subject, Electricity, have turned to Buffalo, and it has been the Mecca of many an electric pilgrim. On its outskirts behold the wildest dreams of the Thousand Nights outdone ! Science, ever triumphing over Nature, has harnessed that most beautiful of all Nature's handiwork, and as though by the subtle touch of the wand of a magician, the very country has been metamorphosed, the solitary places have become veritable hives of human industry, and massive factories are seen on every side where, but a few short years ago, were found nought but vacant fields, the outcome of the mighty power of Niagara transformed and transmitted.

To us, witnessing this for the first time, it is as a milestone of progress illustrating man's ingenuity, the triumph of his brain. Buffalo is truly the electrical city of the age, but she has been so accustomed of recent years to deal with electricity on such a gigantic scale that I am afraid she is overlooking much that to her may appear infinitesimal. Here, of all places, one would naturally expect to find a perfect hotbed of electricity and of all that appertains thereto ; but in one path I greatly fear she is a little behind the times, if she will pardon my saying so, and for that reason I wish to place the aims and claims of our Association fairly and frankly before her.

The necessity for the existence of such an Association as ours has been questioned not only here but elsewhere, hence it is necessary to explain our position. It has been asked, why should

there be an Electro-Therapeutic Association at all ; electricity is only one of many therapeutic agents, and it would be absurd to have a separate society to consider each therapeutic agent ? At first glance this may seem quite a rational contention, but let us consider it carefully.

Our colleges teach us how to administer opium and its various derivatives, therefore the necessity for an opium society does not exist ; but do our colleges, as a rule, teach us anything about electricity worthy of the subject ? The answer to this question is quite unnecessary in presence of the members of our Association. Any physician should be depended upon to prescribe and administer the ordinary or even the extraordinary remedies, or carry out any regulation form of treatment ; but I, for one, should greatly fear to trust to the tender mercies of the general practitioner of to-day, did he in his wisdom consider it necessary to use this agent, electricity, unless he had paid some special attention to the mastery of it. No, the contention is an absurdity unworthy of America, the vaunted land of progress, and of Buffalo, the electrical city. In my own land even, we are more enlightened than that.

This is an age of specialism. We have hardly yet reached the stage humorously depicted by Oliver Wendell Holmes, when one specialist confines himself to treating diseases of the apex of the right lung, while another restricts himself to dealing with those of the base of the left ; but the old-time practitioner—physician and surgeon, too—seems passing away. Surgery is being divided and sub-divided until at one time we feared that we were to be confronted with an appendix surgeon ; and our patients are reaping the benefit of it all. Why then should we call a halt ? No, let “Onward” be our cry ! The time is past when the physician, proud possessor of a solitary magneto-electric machine turned by a crank, considers his armamentarium electricum quite complete ; and electric shocks are seldom spoken of now in polite society. Deeply have we delved in the ever alluring mines of knowledge. Ask our least enthusiastic member will he retreat ? One has to but glance at our programme to see to what extent electricity may be used, and used to advantage, such a programme should prove a perfect revelation to him who has not kept well up with the advances of this progressive age, and a sufficient reply to the contention that our

Association is superfluous and unnecessary. Could our programme, or one one-hundredth part of it, be intelligently comprehended and discussed in any other existing society to-day not dealing distinctly with the subject? No! I greatly fear it would prove a hidden book, a stumbling-block, a shibboleth. There is no man living who is in a position to say with any degree of accuracy that he knows all there is to be known about any branch of science, especially is this true with regard to electricity. How shall the lamentable ignorance with regard to electro-therapeutics be combated, how shall knowledge displace it if not through a medium such as this Association affords?

Not every one is equally qualified to use electricity as a therapeutic agent. The general practitioner who possesses the necessary apparatus, can take proper care of it, is endowed with the ability to use it skilfully, has an accurate knowledge of its fundamental laws, and can properly estimate the wonderful power of this alluring agent, is competent to employ it. Should he not find himself in this position, let him avoid the whole subject as he would a quicksand. The hope of the future lies in those who now are thronging Wisdom's halls, and it is a subject for congratulation that this Association is to be asked to take action, bringing the needs of the hour before the authorities competent to deal with them. The student with mind as yet unwarped by prejudice must be put in a position to obtain a comprehensive, intelligent grasp of the whole subject, that he may turn his theories to practical account in his professional career. But even he, unless endowed by those inestimable blessings, common-sense, patience and gentleness, will find his efforts unavailing; and he must be a close observer of Nature and her laws, seeking to assist rather than to combat her. A great responsibility rests upon our educators, and the sooner they awake from their strange lethargy, the better will it be for our reputation as an enlightened, progressive, scientific profession. The commercial world has taken such advantage of the rapid strides of electricity as a science with fixed laws that we have laid ourselves open to the charge of neglect. Let us hasten to make amends for the past and remove some of the reproaches that rest on the noblest profession in this fair world.

Our Association was organized some eight years ago, because it

was felt that the subject of electro-therapeutics could not be discussed in any existing society in a scientific and practical manner without controversial digressions of no value whatever. It was felt, and felt strongly, that electricity had been left too long to the charlatan, the incompetent and the unscrupulous. It was also felt that we had another foe of hardly less dangerous character, the over-zealous enthusiast. To combat all these and cultivate and promote knowledge of electricity wherever it can be of service in medicine and surgery is the object of our Association ; and it must be admitted that we have set about this in the most practical manner possible ; in fact, I know of no other association in which more practical or more useful work is being done. To carry out the idea successfully, we have called in the assistance of other than purely medical practitioners, and the co-operation has proved most happy, and fruitful of nothing but good. With us the electrical engineer and expert study the laws and note the action of electricity upon inert matter. The biologist and physicist go a step further, and examine these laws in their effects upon living tissue, and their labors are turned to practical account by the physician and surgeon. The curative and palliative powers of the agent are thus considered step by step, and different departments of work are assigned to standing committees, whose duties are continuous and no sinecure, and whose reports, presented yearly, are of inestimable value. The manufacturer has been a great gainer by all this, and, as a result, we have improved apparatus, and much that is useless has been discarded.

We ask, then, could electro-therapy have made such progress had investigation and practice been entrusted to other medical societies, which, be it granted, are doing good work in their respective spheres ? Certainly not. Again, the subject requires special qualifications for successful research, and for this reason the co-operation of the expert and the electrical engineer has proved of inestimable value, yet these men would find no place in the ranks of other medical societies.

A word as to our active membership—those who alone are entitled to vote, and who control the affairs of the Association. We do not pose as “electrical specialists,” and feel that the term “electrician,” as applied to medical men, is a most unfortunate

one, a misnomer, a cognomen none of us aspires to. We are simply medical practitioners, striving to the best of our feeble ability to add to the sum of human knowledge and find out all that is to be known of the true therapeutic value of this wonderful agent, most potent for weal or woe ; and, in acquiring that knowledge, seeking to put it to practical use in our daily labors in the alleviation of suffering and the cure of maladies.

A trite old maxim has it, "First be sure you are right, then go ahead." Being firmly convinced that we are right, we are going ahead as rapidly as prejudice will allow us. But the clouds are breaking on our horizon, the outlook is most hopeful, everywhere we see prejudice vanquished. On my side of that imaginary line, the boundary, we find increasing interest being manifested, and it gives me the greatest pleasure and the greatest satisfaction to say that the warmest friends in the city of my adoption are the men who stand in the front ranks of medicine and surgery, and electro-therapy has a recognized standing, insomuch that special departments devoted to it are to be found in our public hospitals, four of which departments, in as many hospitals, I have had the honor to organize ; and more intelligent inquiries are being made by the students of the various medical colleges.

To recur to our programme, note how widely scattered are those who contribute to it, confined not to this continent alone. Mark the varieties of treatment which will be considered, and the range of diseases that will engage our attention, and the experimental as well as practical, and other uses of the agent that will be touched upon. It has been arranged in such a manner and the subjects have been grouped in such a way as to best meet the demands of the busy practitioner. Nay, we have gone yet further, in that there has been planned for the special benefit of those having no extraordinary knowledge of the subject, a series of short talks, free from technicalities, on matters which it was felt might be of some interest to the practitioner who was too busy to attend all our sessions and yet wished to obtain light on points where electricity might be of some value to him in his work—what cases, in fact, he might, with any promise of success, refer to those competent to deal with them if he had neither the knowledge, nor the necessary time, nor the apparatus to carry out such procedures

himself ; for, be it noted, we are not selfish ; the results of our labors are always at the disposal of the medical profession generally, whether members or not ; our scientific sessions are ever open to them, the privileges of the floor and free discussion are theirs, and a very cordial invitation—which is no mere formality—is always cheerfully extended ; and this year, I am glad to say, we welcome, in addition, the accredited delegates of many other medical societies. This harmony and interchange of opinions will, we trust, be productive of the best of results, removing many misapprehensions and misconceptions, and widening and strengthening the fraternal bond that unites our noble profession in the never-ceasing battle which it wages against the common enemy.

Thus do we endeavor to promote the object for which, a few short years ago, the Association was organized, the cultivation and promotion of knowledge in whatever pertains to the applications of electricity in medicine and surgery.

Electricity has its limitations, we admit quite freely and openly, and these we strive to determine as well as its uses. We do not claim that it is a cure-all, and we laugh to scorn the man who does. None but an imposter claims that electricity is life—it is frequently the reverse. It is a most dangerous agent in unskilled hands, and is at all times to be most carefully employed, and that only by those experienced in its use. It is not accountable for all the failures registered against it, but we do claim that properly used and applied, surgical intervention is sometimes rendered unnecessary by its employment, and that in those cases in which surgical relief is necessary the operation is not prejudiced by its legitimate use. Surely all our contributors can not be classed as infatuates, imposters or humbugs !

In many associations little time is devoted to the discussion of papers ; with us, discussion has ever been a prominent feature, and here, we trust it will be very free, if of necessity somewhat limited on account of the number who have kindly responded to the call for contributions.

Let me venture to express the hope that, as a result of this meeting, we shall have increased interest in this most important subject leading to accessions to our membership from the fair city

in which we meet. Buffalo is an essentially modern city with its busy life, rapid progress, and substantial growth. In casting over in your minds the various, and ever varying uses of that modern revolutionizer so marvellously brought to your very doors, do not be blinded by the advent of it in its glorious strength, but spare time in your busy lives to devote more attention to its uses in the smaller quantities—I mean the therapeutical uses—and you will not regret your action.

To our members I would say, forge on ahead, halt not, speak in no doubtful tones ; but avoid sedulously a pitfall that ever lies in the path of the enthusiastic: be not over-zealous, be discrete, make no claims you cannot fully substantiate.

I must repeat the plea of an honored predecessor for more electro-biology ; there is much room for such investigation. Be not content with present achievements, we are hardly yet upon the threshold of knowledge.

To our committees I would say, that while as a rule active, you do not quite come up to all that might be expected of you ; more work, more work we ask of you. The *personnel* of our committees is also a matter which requires reorganizing and pruning. A figure-head, while of value in some positions, is worse than useless here. The selection of those who are to act, I have felt, is left too much to haphazard. We should have some means of determining who are most competent to serve and most capable of faithful work. I am not sure that it would not be wise for members to volunteer their services, stating in which branch they are most interested ; from a list thus formed choice might be made.

Another duty, I regret to say, is often delayed, sometimes altogether neglected, the answering of correspondence. Let me impress upon you the necessity for prompt response to all letters, at the same time avoiding unnecessary writing ; an altogether out of proportion amount of correspondence is demanded of your President in order to ensure the success of the meeting. Your Secretary is also sorely taxed, being asked at times to do the work of two men ; faithful work well performed merits a substantial honorarium to the holder of an office of such responsibility and importance.

The appointment to your presidency of a non-resident of the

city in which you are to meet is a mistake, never, I hope, to be repeated, unless a fixed place of meeting should be decided upon.

The Executive Council should meet immediately upon adjournment, thereby saving time, money and correspondence; and might, with much profit to the Association and economy to themselves, vote by mail, instead of waiting until a suitable occasion arose when a quorum would be available; and in election to this office the desirability of securing a quorum within reachable distance of one another should be borne in mind,

The Transactions might be published at a much earlier date if members would not request the privilege of revising papers once read, and the rule that papers must be handed to the Secretary immediately upon being read, strictly enforced; publication is greatly delayed by waiting for papers not so handed in, and often, in fact, not even written at the time of meeting. Transactions should be furnished free to members whenever practicable.

The revision of our Constitution removes many past causes of friction.

The resignation of former members is a matter for regret. There should be some means of keeping in our ranks and availing ourselves of the services of those who in the past have proved useful members, but whose time and whose engagements do not now permit of their regular attendance at our meetings, and who once out are forever lost to the Association. Suggestions as to the best method of stopping this leak should engage our earnest consideration. We should also deliberate upon the advisability of changing the time of meeting, which at present is at the end of the holiday season and very close to the opening of the colleges with which many of our members are connected.

And we want new members, active, energetic men, of the right stamp, who will give freely of their time and experience to further the interests, work, and usefulness of the Association.

Finally, a rock we must avoid is that on which many a stronger society than our own has come to grief—the clique; and the furtherance of personal ambitions or personal designs must be sedulously shunned.

## High Frequency Oscillators for Electro-Therapeutic and Other Purposes.

By NIKOLA TESLA, E.E., New York, N. Y.

Some theoretical possibilities offered by currents of very high frequency and observations which I casually made while pursuing experiments with alternating currents, as well as the stimulating influence of the work of Hertz and of views boldly put forth by Oliver Lodge, determined me sometime during 1889 to enter a systematic investigation of high frequency phenomena, and the results soon reached were such as to justify further efforts towards providing the laboratory with efficient means for carrying on the research in this particular field, which has proved itself so fruitful since. As a consequence alternators of special design were constructed and various arrangements for converting ordinary into high frequency currents perfected, both of which were duly described and are now, I assume, familiar.

One of the early observed and remarkable features of the high frequency currents, and one which was chiefly of interest to the physician, was their apparent harmlessness which made it possible to pass relatively great amounts of electrical energy through the body of a person without causing pain or serious discomfort. This peculiarity which, together with other mostly unlooked-for properties of these currents I had the honor to bring to the attention of scientific men first in an article in a technical journal (*Electrical World*, February 19th, 1891), and in subsequent contributions to scientific societies, made it at once evident, that these currents would lend themselves particularly to electro-therapeutic uses.

With regard to the electrical actions in general, and by analogy, it was reasonable to infer that the physiological effects, however complex, might be resolved in three classes: First, the statical, that is such as are chiefly dependent on the magnitude of electrical potential; second, the dynamical, that is those principally dependent on the quantity of electrical movement or current's strength through the body; and third, effects of a distinct nature due to electrical waves or oscillations, that is impulses in which the

electrical energy is alternately passing in more or less rapid succession through the static and dynamic forms.

Most generally in practice these different actions are co-existent, but by a suitable selection of apparatus and observance of conditions the experimenter may make one or other of these effects predominate. Thus he may pass through the body, or any part of the same, currents of comparatively large volume under a small electrical pressure, or he may subject the body to a high electrical pressure while the current is negligibly small, or he may put the patient under the influence of electrical waves transmitted, if desired, at considerable distance through space.

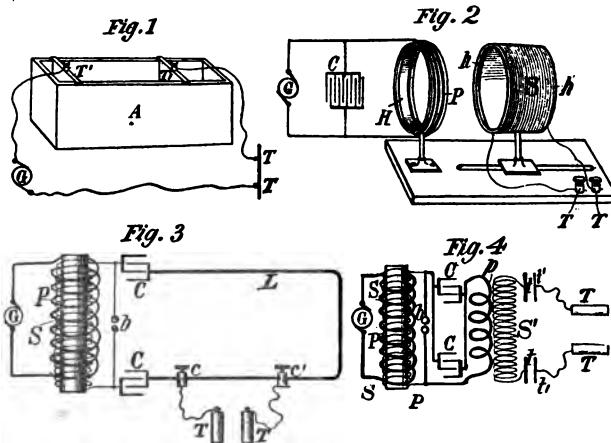
While it remained for the physician to investigate the specific actions on the organism and indicate proper methods of treatment, the various ways of applying these currents to the body of a patient suggested themselves readily to the electrician.

As one cannot be too clear in describing a subject, a diagrammatic illustration of the several modes of connecting the circuits which I will enumerate, though obvious for the majority, is deemed of advantage.

The first and simplest method of applying the currents was to connect the body of the patient to two points of the generator, be it a dynamo or induction coil. Fig. 1 is intended to illustrate this case. The alternator G may be one giving from five to ten thousand complete vibrations per second, this number being still within the limit of practicability. The electromotive force—as measured by a hot wire instrument—may be from fifty to one hundred volts. To enable strong currents to be passed through the tissues, the terminals T T, which serve to establish contact with the patient's body should, of course, be of large area, and covered with cloth saturated with a solution of electrolyte harmless to the skin, or else the contacts are made by immersion. The regulation of the currents is best effected by means of an insulating trough A, provided with two metal terminals T' T' of considerable surface, one of which at least should be movable. The trough is filled with water, and an electrolytic solution is added to the same, until a degree of conductivity is obtained suitable for the experiments.

When it is desired to use small currents of high tension, a secondary coil is resorted to, as illustrated in Fig. 2. I have found it

from the outset convenient to make a departure from the ordinary way of winding the secondary coils with a considerable number of small turns. For many reasons the physician will find it better to provide a large hoop H, of not less than, say, three feet in diameter and preferably more, and to wind upon it a few turns of stout cable P. The secondary coil S is easily prepared by taking two wooden hoops h h and joining them with stiff cardboard. One single layer of ordinary magnet wire, and not too thin at that, will be generally sufficient, the number of turns necessary for the particular use for which the coil is intended being easily ascertained



by a few trials. Two plates of large surface, forming an adjustable condenser, may be used for the purpose of synchronizing the secondary with the primary circuit, but this is generally not necessary. In this manner a cheap coil is obtained, and one which cannot be easily injured. Additional advantages, however, will be found in the perfect regulation which is effected merely by altering the distance between the primary and secondary, for which adjustment provision should be made; and, furthermore, in the occurrence of harmonics which are, naturally, more pronounced in such large coils of thick wire, situated at some distance from the primary.

The preceding arrangements may also be used with alternating

or interrupted currents of low frequency, but certain peculiar properties of high frequency currents make it possible to apply the latter in ways entirely impracticable with the former.

One of the prominent characteristics of high frequency, or to be more general, of rapidly varying currents, is that they pass with difficulty through stout conductors of high self-induction. So great is the obstruction which self-induction offers to their passage that it was found practicable, as shown in the early experiments to which reference has been made, to maintain differences of potential of many thousands of volts between two points—not more than a few inches apart—of a thick copper bar of inappreciable resistance. This observation naturally suggested the disposition illustrated in Fig. 3. The source of high frequency impulses is in this instance a familiar type of transformer, which may be, primarily, supplied from a generator G of ordinary direct or alternating currents. The transformer comprises a primary P, a secondary S, two condensers C C, which are joined in series, a loop or coil of very thick wire L, and a circuit interrupting device or break b. The currents are derived from the loop L by two contacts c c', one or both of which are capable of displacement along the wire L. By varying the distance between these contacts, any difference of potential, from a few volts to many thousand, is readily obtained on the terminals or handles T T. This mode of using the currents is entirely safe and particularly convenient but it requires a very uniform working of the break b, employed for charging and discharging the condenser.

Another equally remarkable feature of high frequency impulses was found in the facility with which they are transmitted through condensers, moderate electromotive forces and very small capacities being required to enable currents of considerable volume to pass. This observation made it practicable to resort to a plan such as indicated in Fig. 4. Here the connections are similar to those shown in the preceding case, except that the condensers C C are joined in parallel. This lowers the frequency of the currents, but has the advantage of allowing the working with a much smaller difference of potential on the terminals of the secondary S. Since the latter is the chief item of expense of such apparatus, and since its price rapidly increases with the number of turns required, the

experimenter will find it generally cheaper to make a sacrifice in the frequency which, as a rule, will be high enough for most purposes. However, he only needs to reduce proportionately the number of turns or the length of primary p to obtain the same frequency as before, but the economy of transformation will be somewhat reduced in so doing, and the break b will require more attention. The secondary S<sup>1</sup> of the high frequency coil has two metal plates t t, of considerable surface, connected to its terminals, and the current for use is derived from two similar plates t' t', in proximity to the former. Both the tension and volume of the currents taken from the latter plates may be easily regulated, and in a continuous manner, by simply varying the distance between the two pair of plates t t and t' t', respectively.

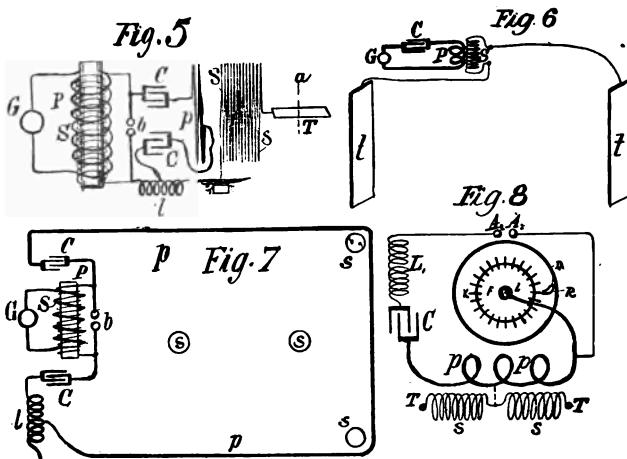
A facility is also afforded in this disposition for raising or lowering the potential of one of the terminals T, irrespective of the changes produced on the other terminal, this making it possible to cause a stronger action on one or other part of the patient's body.

The physician may find it for some or other reason convenient to modify the arrangements in Figs. 2, 3 and 4 by connecting one terminal of high frequency source to the ground. The effects will be in most respects the same, but certain peculiarities will be noted in each case. When a ground connection is made it may be of some consequence which of the terminals of the secondary is connected to the ground, as in high frequency discharges the impulses of one direction are generally preponderating.

Among the various noteworthy features of these currents there is one which lends itself especially to many valuable uses. It is the facility which they afford for conveying large amounts of electrical energy to a body entirely insulated in space. The practicability of this method of energy transmission, which is already receiving useful applications and promises to become of great importance in the near future, has helped to dispel the old notion assuming the necessity of a return circuit for the conveyance of electrical energy in any considerable amount. With novel appliances we are enabled to pass through a wire, entirely insulated at one end, currents strong enough to fuse it, or to convey through the wire any amount of energy to an insulated

body. This mode of applying high frequency currents in medical treatment appears to me to offer the greatest possibilities at the hands of the physician. The effects produced in this manner possess features entirely distinct from those observed when the currents are applied in any of the before-mentioned or similar ways.

The circuit connections, as usually made, are illustrated schematically in Fig. 5, which, with reference to the diagrams before shown, is self-explanatory. The condensers C C, connected in



series, are preferably charged by a step-up transformer, but a high frequency alternator, static machine, or a direct current generator, if it be of sufficiently high tension to enable the use of small condensers, may be used with more or less success. The primary p, through which the high frequency discharges of the condensers are passed, consists of very few turns of cable of as low resistance as possible, and the secondary s, preferably at some distance from the primary to facilitate free oscillation, has one of its ends—that is the one which is nearer to the primary—connected to the ground, while the other end leads to an insulated terminal T, with which the body of the patient is connected. It is of importance in this

case to establish synchronism between the oscillations in the primary and secondary circuits p and s, respectively. This will be as a rule best effected by varying the self-induction of the circuit, including the primary loop or coil p, for which purpose an adjustable self-induction l is provided ; but in cases when the electro-motive force of the generator is exceptionally high, as when a static machine is used and a condenser consisting of merely two plates offers sufficient capacity, it will be simpler to attain the same object by varying the distance of the plates.

The primary and secondary oscillations being in close synchronism, the points of highest potential will be on a part of terminal T, and the consumption of energy will occur chiefly there. The attachment of the patient's body to the terminal will, in most cases, very materially affect the period of oscillation in the secondary, making it longer, and a readjustment of the primary circuit will have to be made in each case to suit the capacity of the body connected with terminal T. Synchronism should always be preserved, and the intensity of the action varied by moving the secondary coil to or from the primary, as may be desired. I know of no method which would make it possible to subject the human body to such excessive electrical pressures as are practicable with this, or of one which would enable the conveying to and giving off from the body without serious injury amounts of electrical energy approximating even in a remote degree those which are entirely practicable when this manner of applying the energy is resorted to. This is evidently due to the fact that the action is chiefly superficial, the largest possible section being offered to the transfer of the current, or, to say more correctly, of the energy. With a very rapidly and smoothly working break I would not think it impossible to convey to the body of a person and to give off into the space energy at the rate of several horse power with impunity, while a small part of this amount applied in other ways could not fail to produce injury.

When a person is subjected to the action of such a coil, the proper adjustments being carefully observed, luminous streams are seen in the dark issuing from all parts of the body. These streams are short and of delicate texture when the number of breaks is very great and the action of the device b (Fig. 5) free of any

irregularities, but when the number of breaks is small or the action of the device imperfect, long and noisy streams appear which cause some discomfort. The physiological effects produced with apparatus of this kind may be graduated from a hardly perceptible action when the secondary is at a great distance from the primary, to a most violent one when both coils are placed at a small distance. In the latter case only a few seconds are sufficient to cause a feeling of warmth all over the body, and soon after the person perspires freely. I have repeatedly, in demonstrations to friends, exposed myself longer to the action of the oscillations, and each time, after the lapse of an hour or so, an immense fatigue, of which it is difficult to give an idea, would take hold of me. It was greater than I experienced on some occasions after the most straining and prolonged bodily exertion. I could scarcely make a step and could keep the eyes open only with the greatest difficulty. I slept soundly afterward, and the after-effect was certainly beneficial but the medicine was manifestly too strong to be used frequently.

One should be cautious in performing such experiments for more than one reason. At or near the surface of the skin, where the most intense action takes place, various chemical products are formed, the chief being ozone and nitrogen compounds. The former is itself very destructive, this feature being illustrated by the fact that the rubber insulation of a wire is destroyed so quickly as to make the use of such insulation entirely impracticable. The compounds of nitrogen, when moisture is present, consist largely of nitric acid, which might, by excessive application, prove hurtful to the skin. So far, I have not noted injuries which could be traced directly to this cause, though on several occasions burns were produced in all respects similar to those which were later observed and attributed to the Roentgen rays. This view is seemingly being abandoned, having not been substantiated by experimental facts, and so also is the notion that these rays are transverse vibrations. But while investigation is being turned in what appears to be the right direction, scientific men are still at sea. This state of things impedes the progress of the physicist in these new regions, and makes the already hard task of the physician still more difficult and uncertain.

One or two observations made while pursuing experiments with the apparatus described might be found as deserving mention here. As before stated, when the oscillations in the primary and secondary circuits are in synchronism, the points of highest potential are on some portion of the terminal T. The synchronism being perfect and the length of the secondary coil just equal to one-quarter of the wave length, these points will be exactly on the free end of terminal T, that is, the one situated farthest from the end of the wire attached to the terminal. If this be so, and if now the period of the oscillations in the primary be shortened, the points of highest potential will recede towards the secondary coil, since the wave-length is reduced and since the attachment of one end of the secondary coil to the ground determines the position of the nodal points ; that is, the points of least potential. Thus, by varying the period of vibration of the primary circuit in any manner, the points of highest potential may be shifted accordingly along the terminal T, which has been shown, designedly, long to illustrate this feature. The same phenomenon is, of course, produced if the body of a patient constitutes the terminal, and an assistant may, by the motion of a handle, cause the points of highest potential to shift along the body with any speed he may desire. When the action of the coil is vigorous, the region of highest potential is easily and unpleasantly located by the discomfort or pain experienced, and it is most curious to feel how the pain wanders up and down, or eventually across the body, from hand to hand, if the connection to the coil is accordingly made—in obedience to the movement of the handle controlling the oscillations. Though I have not observed any specific action in experiments of this kind, I have always felt that this effect might be capable of valuable use in electro-therapy.

Another observation which promises to lead to much more useful results is the following : As before remarked, by adopting the method described, the body of a person may be subjected without danger to electrical pressures vastly in excess of any producible by ordinary apparatus, for they may amount to several million volts, as has been shown in actual practice. Now, when a conducting body is electrified to so high a degree, small particles, which may be adhering firmly to its surface, are torn off with

violence and thrown to distances which can be only conjectured. I find that not only firmly adhering matter, as paint, for instance, is thrown off, but even the particles of the toughest metals are torn off. Such actions have been thought to be restricted to a vacuous inclosure, but with a powerful coil they occur also in the ordinary atmosphere. The facts mentioned would make it reasonable to expect that this extraordinary effect which, in other ways, I have already usefully applied, will likewise prove to be of value in electro-therapy. The continuous improvement of the instruments and the study of the phenomenon may shortly lead to the establishment of a novel mode of hygienic treatment which would permit an instantaneous cleaning of the skin of a person, simply by connecting the same to, or possibly, by merely placing the person in the vicinity of a source of intense electrical oscillations, this having the effect of throwing off, in a twinkle of the eye, dust or particles of any extraneous matter adhering to the body. Such a result brought about in a practicable manner would, without doubt, be of incalculable value in hygiene and would be an efficient and time-saving substitute for a water bath, and particularly appreciated by those whose contentment consists in undertaking more than they can accomplish.

High frequency impulses produce powerful inductive actions and, in virtue of this feature, they lend themselves in other ways to the uses of the electro-therapeutist. These inductive effects are either electrostatic or electrodynamic. The former diminish much more rapidly with the distance—with the square of the same—the latter are reduced simply in proportion to the distance. On the other hand, the former grow with the square of intensity of the source, while the latter increase in a simple proportion with the intensity. Both of these effects may be utilized for establishing a field of strong action extending through considerable space, as through a large hall, and such an arrangement might be suitable for use in hospitals or institutions of this kind, where it is desirable to treat a number of patients at the same time.

Fig. 6 illustrates the manner, as I have shown it originally, in which such a field of electrostatic action is established. In this diagram G is a generator of currents of very high frequency and C a condenser for counteracting the self-induction of the circuit

which includes the primary P of an induction coil, the secondary S of which has two plates t t, of large surface, connected to its terminals. Well known adjustments being observed, a very strong action occurs chiefly in the space between the plates, and the body of a person is subjected to rapid variations of potential and surges of current, which produce, even at a great distance, marked physiological effects. In my first experiments I used two metal plates as shown, but later I found it preferable to replace them by two large hollow spheres of brass covered with wax of a thickness of about two inches. The cables leading to the terminals of the secondary coil were similarly covered, so that any of them could be approached without danger of the insulation breaking down. In this manner the unpleasant shocks, to which the experimenter was exposed when using the plates, were prevented.

In Fig. 7 a plan for similarly utilizing the dynamic inductive effects of high frequency currents is illustrated. As the frequencies obtainable from an alternator are not as high as is desired, conversion by means of condensers is resorted to. The diagram will be understood at a glance from the foregoing description. It only need be stated that the primary p, through which the condensers are made to discharge, is formed by a thick stranded cable of low self-induction and resistance, and passes all around the hall. Any number of secondary coils s s s, each consisting generally of a single layer of rather thick wire, may be provided. I have found it practicable to use as many as one hundred, each being adjusted for a definite period and responding to a particular vibration passed through the primary. Such a plant I have had in use in my laboratory since 1892, and many times it has contributed to the pleasure of my visitors and also proved itself of practical utility. On a latter occasion I had the pleasure of entertaining some of the members with experiments of this kind, and this opportunity I cannot let pass without expressing my thanks for the interest which was awakened in me by their visit, as well as for the generous acknowledgment of the courtesy by the Association. Since that time my apparatus has been very materially improved, and now I am able to create a field of such intense induction in the laboratory that a coil three feet in diameter, by careful adjustment, will deliver

energy at the rate of one-quarter of a horse power, no matter where it is placed within the area inclosed by the primary loops. Long sparks, streamers and all other phenomena obtainable with induction coils are easily producible anywhere within the space, and such coils, though not connected to anything, may be utilized exactly as ordinary coils ; and, what is still more remarkable, they are more effective. For the past few years I have often been urged to show these experiments in public, but, though I was desirous to comply with such requests, pressing work has so far made it impossible. These advances have been the result of slow but steady improvements in the details of the apparatus, which I hope to be able to describe connectedly in the near future.

However remarkable the electrodynamic inductive effects, which I have mentioned, may appear, they may be still considerably intensified by concentrating the action upon a very small space. It is evident that since, as before stated, electromotive forces of many thousand volts are maintained between two points of a conducting bar or loop only a few inches long, electromotive forces of approximately the same magnitude will be set up in conductors situated near by. Indeed, I found that it was practicable in this manner to pass a discharge through a highly-exhausted bulb, although the electromotive force required amounted to as much as ten or twenty thousand volts, and for a long time I followed up experiments in this direction with the object of producing light in a novel and more economical way. But the tests left no doubt that there was great energy consumption attendant to this mode of illumination, at least with the apparatus I had then at command, and, finding another method which promised a higher economy of transformation, my efforts turned in this new direction. Shortly afterward (some time in June, 1891) Prof. J. J. Thomson described experiments which were evidently the outcome of long investigation, and in which he supplied much novel and interesting information, and this made me return with renewed zeal to my own experiments. Soon my efforts were centered upon producing in a small space the most intense inductive action, and by gradual improvement in the apparatus I obtained results of a surprising character. For instance, when the end of a heavy bar of iron was thrust within a loop powerfully energized, a few moments were sufficient to raise

the bar to a high temperature. Even heavy lumps of other metals were heated as rapidly as though they were placed in a furnace. When a continuous band formed of a sheet of tin was thrust into the loop, the metal was fused instantly, the action being comparable to an explosion, and no wonder, for the frictional losses accumulated in it at the rate of possibly ten horse power. Masses of poorly conducting material behaved similarly, and when a highly-exhausted bulb was pushed into the loop, the glass was heated in a few seconds nearly to the point of melting.

When I first observed these astonishing actions, I was interested to study their effects upon living tissues. As may be assumed, I proceeded with all the necessary caution, and well I might, for I had the evidence that in a turn of only a few inches in diameter an electromotive force of more than ten thousand volts was produced, and such high pressure would be more than sufficient to generate destructive currents in the tissue. This appeared all the more certain as bodies of comparatively poor conductivity were rapidly heated and even partially destroyed. One may imagine my astonishment when I found that I could thrust my hand or any other part of the body within the loop and hold it there with impunity. More than on one occasion, impelled by a desire to make some novel and useful observation, I have willingly or unconsciously performed an experiment connected with some risk, this being scarcely avoidable in laboratory experience, but I have always believed, and do so now, that I have never undertaken anything in which, according to my own estimation, the chances of being injured were so great as when I placed my head within the space in which such terribly destructive forces were at work. Yet I have done so, and repeatedly, and have felt nothing. But I am firmly convinced that there is great danger attending such an experiment, and some one going just a step farther than I have gone may be instantly destroyed; for conditions may exist similar to those observable with a vacuum bulb. It may be placed in the field of the loop, however intensely energized, and so long as no path for the current is formed, it will remain cool and consume practically no energy. But the moment the first feeble current passes, most of the energy of the oscillations rushes to the place of consumption. If by any action whatever, a

conducting path were formed within the living tissue or bones of the head, it would result in the instant destruction of these and death of the foolhardy experimenter. Such a method of killing, if it were rendered practicable, would be absolutely painless. Now, why is it that in a space in which such violent turmoil is going on living tissue remains uninjured? One might say the currents cannot pass because of the great self-induction offered by the large conducting mass. But this it cannot be, because a mass of metal offers a still higher self-induction and is heated just the same. One might argue the tissues offer too great a resistance. But this, again, cannot be the reason, for all evidence shows that the tissues conduct well enough, and besides, bodies of approximately the same resistance are raised to a high temperature. One might attribute the apparent harmlessness of the oscillations to the high specific heat of the tissue, but even a rough quantitative estimate from experiments with other bodies shows that this view is untenable. The only plausible explanation I have so far found is that the tissues are condensers. This only can account for the absence of injurious action. But it is remarkable that, as soon as a heterogeneous circuit is constituted, as by taking in the hands a bar of metal and forming a closed loop in this manner, the passage of the currents through the arms is felt, and other physiological effects are distinctly noted. The strongest action is, of course secured when the exciting loop makes only one turn, unless the connections take up a considerable portion of the total length of the circuit, in which case the experimenter should settle upon the least number of turns by carefully estimating what he loses by increasing the number of turns, and what he gains by utilizing thus a greater proportion of the total length of the circuit. It should be borne in mind that, when the exciting coil has a considerable number of turns and is of some length, the effects of electrostatic induction may preponderate, as there may exist a very great difference of potential—a hundred thousand volts or more—between the first and last turn. However, these latter effects are always present even when a single turn is employed.

When a person is placed within such a loop, any pieces of metal, though of small bulk, are perceptibly warmed. Without doubt they would be also heated—particularly if they were of iron—when

imbedded in living tissue, and this suggests the possibility of surgical treatment by this method. It might be possible to sterilize wounds, or to locate, or even to extract metallic objects, or to perform other operations of this kind within the sphere of the surgeon's duties in this novel manner.

Most of the results enumerated, and many others still more remarkable, are made possible only by utilizing the discharges of a condenser. It is probable that but a very few—even among those who are working in these identical fields—fully appreciate what a wonderful instrument such a condenser is in reality. Let me convey an idea to this effect. One may take a condenser, small enough to go in one's vest pocket, and by skilfully using it he may create an electrical pressure vastly in excess—a hundred times greater, if necessary—than any producible by the largest static machine ever constructed. Or, he may take the same condenser and, using it in a different way, he may obtain from it currents against which those of the most powerful welding machine are utterly insignificant. Or again, he may avail himself of the same marvellous instrument and, by suddenly discharging its stored electricity he may create such a terrific commotion in the space that, though silent and invisible, it can be detected, as actually demonstrated, at distances much greater than those at which the sound of the largest gun is perceptible, distances which are measured in tens, perhaps hundreds or even thousands of miles. Those who are imbued with popular notions as to the pressures of static machines and currents obtainable with a commercial transformer, will be astonished at the preceding statements—yet the truth of them is easy to see. Such results are obtainable, and easily, because the condenser can discharge the stored energy in an inconceivably short time. Nothing like this property is known in physical science. A compressed spring, or a storage battery, or any other form of device capable of storing energy cannot do this; if they could, things undreamt of at present might be accomplished by their means. The nearest approach to a charged condenser is a high explosive, as dynamite. But even the most violent explosion of such a compound bears no comparison with the discharge or explosion of a condenser. For, while the pressures which are produced in the detonation of a chemical compound are measured in

tens of tons per square inch, those which may be caused by condenser discharges may amount to thousands of tons per square inch, and if a chemical could be made which would explode as quickly as a condenser can be discharged under conditions which are realizable—an ounce of it would quite certainly be sufficient to render useless the largest battleship.

That important realizations would follow from the use of an instrument possessing such ideal properties I have been convinced since long ago, but I also recognized early that great difficulties would have to be overcome before it could replace less perfect implements now used in the arts for the manifold transformations of electrical energy. These difficulties were many. The condensers themselves, as usually manufactured, were inefficient, the conductors wasteful, the best insulation inadequate, and the conditions for the most efficient conversion were hard to adjust and to maintain. One difficulty, however, which was more serious than the others, and to which I called attention when I first described this system of energy transformation, was found in the devices necessarily used for controlling the charges and discharges of the condenser. They were wanting in efficiency and reliability and threatened to prove a decided drawback, greatly restricting the use of the system and depriving it of many valuable features. For a number of years I have tried to master this difficulty. During this time a great number of such devices were experimented upon. Many of them promised well at first, only to prove inadequate in the end. Reluctantly, I came back upon an idea on which I had worked long before. It was to replace the ordinary brushes and commutator segments by fluid contacts. I had encountered difficulties then, but the intervening years in the laboratory were not spent in vain, and I made headway. First it was necessary to provide for a circulation of the fluid, but forcing it through by a pump proved itself impractical. Then the happy idea presented itself to make the pumping device an integral part of the circuit interrupter, inclosing both in a receptacle to prevent oxydation. Next some simple ways of maintaining the circulation, as by rotating a body of mercury, presented themselves. Then I learned how to reduce the wear and losses which still existed. I fear that these statements, indicating how much effort was spent

in these seemingly insignificant details will not convey a high idea of my ability, but I confess that my patience was taxed to the utmost. Finally, though, I had the satisfaction of producing devices which are simple and reliable in their operation, which require practically no attention, and which are capable of effecting a transformation of considerable amounts of energy with fair economy. It is not the best that can be done by any means, but it is satisfactory, and I feel that the hardest task is done.

The physician will now be able to obtain an instrument suitable to fulfil many requirements. He will be able to use it in electro-therapeutic treatment in most of the ways enumerated. He will have the facility of providing himself with coils such as he may desire to have for any particular purpose, which will give him any current or any pressure he may wish to obtain. Such coils will consist of but a few turns of wire, and the expense of preparing them will be quite insignificant. The instrument will also enable him to generate Roentgen rays of much greater power than obtainable with ordinary apparatus. A tube must still be furnished by the manufacturers which will not deteriorate, and which will allow to concentrate larger amounts of energy upon the electrodes. When this is done, nothing will stand in the way of an extensive and efficient application of this beautiful discovery, which must ultimately prove itself of the highest value, not only at the hands of the surgeon, but also of the electro-therapist, and, what is most important, of the bacteriologist.

To give a general idea of an instrument in which many of the latter improvements are embodied, I would refer to Fig. 9, which illustrates the chief parts of the same in side elevation and partially in vertical cross-section. The arrangement of the parts is the same as in the form of instrument exhibited on former occasions, only the exciting coil with the vibrating interrupter is replaced by one of the improved circuit breakers to which reference has been made.

This device comprises a casting A, with a protruding sleeve B, which, in a bushing, supports a freely rotatable shaft a. The latter carries an armature within a stationary field magnet M, and on the top a hollow iron pulley D, which contains the break proper. Within the shaft a, and concentrically with the same, is placed a smaller

shaft b, likewise freely movable on ball-bearings and supporting a weight E. This weight being on one side and the shafts a and b inclined to the vertical, the weight remains stationary as the pulley is rotated. Fastened to the weight E is a device R in the form of a scoop with very thin walls, narrow on the end nearer to the pulley and wider on the other end. A small quantity of mercury being placed in the pulley and the latter rotated against the narrow end of the scoop, a portion of the fluid is taken up and thrown in a thin and wide stream towards the centre of the pulley. The

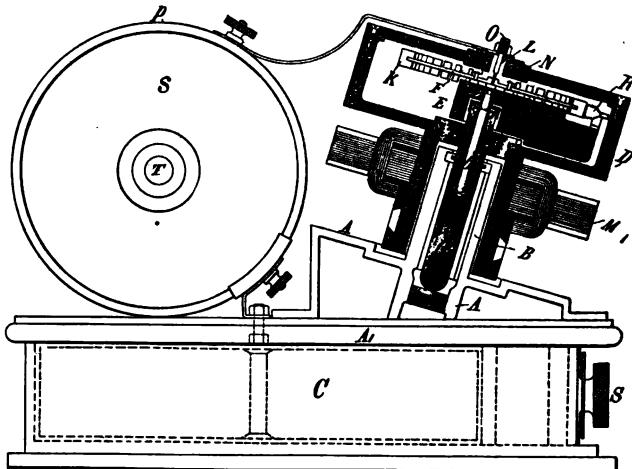


FIG. 9.

top of the latter is hermetically closed by an iron washer, as shown, this washer supporting on a steel rod L a disk F of the same metal provided with a number of thin contact blades K. The rod L is insulated by washers N from the pulley, and for the convenience of filling in the mercury a small screw O is provided. The bolt L forming one terminal of the circuit breaker is connected by a copper strip to the primary p. The other end of the primary coil leads to one of the terminals of the condenser C, contained in a compartment of a box A, another compartment of

the same being reserved for switch S and terminals of the instrument. The other terminal of the condenser is connected to the casting A and through it to pulley D. When the pulley is rotated the contact blades K are brought rapidly in and out of contact with the stream of mercury, thus closing and opening the circuit in quick succession. With such a device it is easy to obtain ten thousand makes and breaks per second, and even more. The secondary S is made of two separate coils, and so arranged that it can be slipped out, and a metal strip in its middle connects it to the primary coil. This is done to prevent the secondary from breaking down when one of the terminals is overloaded, as it often happens in working Roentgen bulbs. This form of coil will withstand a very much greater difference of potential than coils as ordinarily constructed.

The motor has both field and armature build of plates, so that it can be used on alternating as well as direct current supply circuits, and the shafts are as nearly as possible vertical, so as to require the least care in oiling. Thus, the only thing which really requires some attention is the commutator of the motor, but where alternating currents are always available, this source of possible trouble is easily done away with.

The circuit connections of the instrument have been already shown, and the mode of operation explained in periodicals. The usual manner of connecting is illustrated in Fig. 8, in which A<sub>1</sub>, A<sub>2</sub> are the terminals of the supply circuit L, a self-induction coil for raising the pressure, which is connected in series with condenser C and primary P. P. The remaining letters designate the parts correspondingly marked in Fig. 9, and will be understood with reference to the latter.

## Phlebitis, a Clinical Study.

By MARGARET A. CLEAVES, M.D., New York, N.Y.

During the past few years several cases of chronic phlebitis have been under treatment with results so beneficial as to suggest that a report of them may be of interest to the members of the profession.

The first case, E. L. S., reporter, aged 35, male, had for its initial origin a varicose condition of the veins of the left lower leg. The fact that this patient suffered more or less from chronic constipation no doubt contributed to the untoward result. His occupation necessitated much standing and walking. A localized inflammatory action was set up with formation of a thrombus in the external saphenous vein at the junction of the lower and middle third. Treatment was instituted by means of lead lotions, the patient meanwhile continuing at his usual avocation. Pressure was subsequently applied—*i.e.*, a bandage from the ankle to the thigh—by the direction of the attending physician. As a result a coagulum was released, which forming an embolus drifted into the circulation, and found a resting place at the junction of the femoral with the popliteal vein. He was first seen twenty-four hours after the application of the bandage, was then unable to stand or walk, and the leg was swollen, painful and weak. Rest in bed, with attention to bowels and general health was prescribed; and some ten days later, although walking with difficulty, he was able to be upon his feet and to come to the office for treatment.

In January of 1898 a second case, H. R. H., lawyer, aged 38, male, came under observation. General health always good. He contracted typhoid fever in October, 1896, after a hard summer spent continuously in the city. The attack, a severe one, was complicated by shingles, and between the third and fourth weeks a phlebitis of the right leg developed.

It followed the usual course, presenting typical symptoms. The leg was very much swollen and at first extremely painful. In

addition to his enforced recumbency, lead lotions and wrapping in cotton wool were used. Convalescence from fever was finally established, and he was able to leave his house first in January, 1897. At that time the leg was swollen, stiff, especially at knee-joint, and uncomfortable, but not acutely painful. He came under care January 15th, 1898, just a little over a year after getting up from the fever. At no time in his life had there been any varicosities of the veins. During the year the entire leg was implicated, from the ankle to the junction of the thigh with the body, constantly swollen, worse at night, unwieldy and uncomfortable, and it was with the greatest difficulty he could walk or stand. A silk stocking extending from the ankle to above the knee was ordered when he first got up, and after being worn for a number of months was replaced by one from the ankle to the knee. Bicycle exercise was advised by his physician, but was not undertaken owing to the bulk and extreme stiffness of the leg, as well as the constant discomfort experienced. A stationary bicycle was placed in his house, however, upon which he exercised to the best of his ability. Had he been a man of leisure it is possible that by careful gradation of time and strength there might have come a time when sufficient exercise could have been taken to accomplish some good.

At time of coming under care the leg was practically in the same condition as for the preceding year; i.e., stiff, swollen, worse at night, larger than the other (see measurements) and with constant sense of discomfort. Walking and standing increased all the symptoms, especially the swelling, and the legs could only be crossed by raising the affected one with the hands over the other. A silk elastic stocking, worn constantly, from ankle to knee was removed with difficulty at night owing to increase in swelling.

*Physical Examination—*

**Inspection :** Leg apparently much larger than the other ; skin shining, purplish red in color ; inactive in appearance ; no varicosities.

**Palpation :** Temperature lower than in good leg ; skin tense ; no elasticity nor flexibility of tissues, but a brawny feel with sense of infiltration and matting conveyed to the examiner's hand. No pitting on pressure.

*Measurements Taken January 18th, 1898.*

	Right.	Left.
Ankle - - - - -	12 inches.	$11\frac{1}{2}$ inches.
Calf - - - - -	$15\frac{1}{2}$ inches.	$14\frac{1}{2}$ inches.
Above knee - - -	$16\frac{1}{2}$ inches.	15 inches.
Middle of thigh - -	21 inches.	$19\frac{1}{2}$ inches.
Upper thigh - - -	$22\frac{1}{2}$ inches.	$21\frac{1}{4}$ inches.

General health good, general circulation fair, tendency to cold hands, skin of face and body ruddy in color, well nourished, appetite good, no stomach indigestion, sleep good, no heart lesion.

A third case : H. D. S., aged 38, male, civil engineer, came under care March 9th, 1898. In the autumn of 1896 had a very severe attack of typhoid fever coincidently with that of the preceding patient. He was up and about for some time before the nature of his illness was recognized, and even after he had a high temperature. The case was regarded as one of great gravity, and in the fourth week phlebitis developed involving both legs. At first, pain and swelling in both upper legs, which gradually disappeared, but later suddenly returned, with cramping and severe pain under right knee. The entire leg was subsequently involved and the left from ankle to knee. The usual symptoms were present, and the same measures resorted to as in the preceding case.

No improvement made, and later on the actual cautery was used to right leg from ankle to thigh and left from ankle to knee. Convalescence from fever was gradually established, but without improvement so far as the phlebitis was concerned. When first up he walked with crutches, but left the hospital December 26th, 1896, walking with the aid of two canes.

On January 6th, 1897, went to Lake Saranac, in the Adirondacks, by the advice of his physician, who directed that he should take active exercise ; i.e., walk and skate. A few days after arrival at Lake Saranac he went out skating, but soon became very tired and returned to the hotel with great difficulty. In an hour or two his legs were greatly swollen, unwieldy and painful. Medical assistance was summoned, and he was told to keep absolutely still with his legs in a horizontal position. The more acute manifestations

of the trouble passed under this regime, and he shortly afterwards returned to New York and to the physician who had attended him during his attack of fever, who directed him to get a battery, which he did, and used it, but without any knowledge whatever of what he was doing or why he was doing it, as no instructions were given him. In the summer of 1897 there were at different times minute ulcerations on both legs. In December, 1897, becoming impatient of restraint, he removed the elastic stockings which had constantly been worn up to that time. As a result there was breaking down of tissue midway between the knee and ankle and about two inches from the tibial border on the inner aspect of the right leg. The stockings were at once resumed, and this spot after a time healed under the use of hydrozone, but no gain was made so far as swelling, enlargement and disability were concerned. His business kept him pretty constantly on his feet and also called him frequently from the city, delaying the beginning of treatment, but he finally came under care through the preceding patient.

*Physical Examination—*

Silk elastic stockings worn from ankles to knees on both legs on account of weakness of the blood vessels and oedema. Skin of a dull, purplish color, inactive in appearance ; no varicose veins.

A brownish spot at site of former ulceration as large as a silver twenty-five cent piece, while on different parts of both legs were small brownish spots, the site of minute ulcerations and abrasions, due to bruising and breaking the skin. Temperature in both legs less than normal ; less tension of the skin in this case than in the preceding one, but the same brawny feel with sense of infiltration and matting conveyed to the examiner's hand. Pitting on pressure marked—both legs—especially along tibial border, inner aspect of right leg and about former ulcerated area. No measurements taken. Constant stiffness with sensation of clumsiness and discomfort ; patient found it difficult to get around and was unable to move quickly or with normal accuracy. General health good, circulation other than in legs good, skin of face and body of good ruddy color, well nourished, appetite good, stomach indigestion with gaseous eructations, slightly irregular bowels, sleep good, no heart trouble. Patient of extremely nervous temperament and

intolerant of all restraint. Coincidently with the illness of these two patients, a mutual friend had typhoid fever and also developed phlebitis before convalescence was established. From information received concerning his case, it is inferred that resolution took place promptly and that the patient made a very good recovery.

An inflammation of the veins (phlebitis) may involve chiefly the external layers (periphlebitis) or the internal (endophlebitis); or, as is very frequently the case, the entire wall may be affected.

It may be caused by the presence of a thrombus, by injuries, or by infectious inflammation of the surrounding tissues.

Thrombosis of the vein, either primary or secondary, is a very constant accompaniment of phlebitis. An acute phlebitis may commence as a suppurative periphlebitis, or as a result of inflammatory processes about the vessels. The outer layers of the venous walls are congested, swollen, infiltrated with serum and pus.

The inner coats may become infiltrated with pus, or they may be necrotic and disintegrate. Under these conditions a thrombus is constantly formed, which may for a time stop circulation and keep the products of inflammation and degeneration from mixing with the blood; but, on the other hand, the thrombus itself is prone to disintegration, and thus the exudations and decomposing fragments of tissue may enter the circulation. Or, owing to the presence of irritating or infectious material within the veins and the formation of a thrombus, the inflammatory process may be at the commencement an endophlebitis. But usually, if the inflammation is severe, the entire wall of the vessel will eventually be involved.

The pus cells in both cases come, without doubt, from emigration from the vasa-vasorum. An acute phlebitis may terminate in the absorption of the thrombus and the return of the vein to its normal condition, in the obliteration of the vein, or portions of the thrombus may become detached and find their way as emboli into the various portions of the body. In a chronic periphlebitis there may or may not be thrombosis. In the periphlebitis there is a thickening of the outer coats by formation of new connective tissue. The inner coats may also be thickened with an additional thickening of the surrounding tissues coalescing with the walls of the vein and with a marked dilatation of the vasa-vasorum.

This is characteristic of a periphlebitis. An endophlebitis is characterized by an increase of connective tissue in the intima, which may obliterate the lumen of the vein itself. In chronic endophlebitis, which is rarer, the circumscribed patch of new connective tissue may undergo fatty or calcareous degeneration.\*

In phlegmasia dolens or milk leg, the pathological changes are of the same nature as have already been indicated, the condition being that of a true phlebitis. In the cases just detailed, the first was due primarily to the varicose veins and consequent changes in the endothelium, while the other two cases were due to an infection incident upon the pathological changes of typhoid fever.

Arteritis is an occasional complication of typhoid fever, and is generally met with toward the end of the febrile period, but venous thrombosis, a result of the weakness of the heart's action, is more frequently observed. It occurs generally during the convalescence of cases which have run a severe course, and usually affects the veins of the lower extremities. Both femoral veins have been obstructed at the same time. Loomist states that venous thrombi frequently develop in a protracted case of fever, rendering the prognosis unfavorable. The danger always exists of a portion of the thrombus becoming detached and producing an embolism of the pulmonary artery.

Hutchinson† reports that all of his cases recovered from the complication of phlebitis, but does not mention the number. He reports, however, two deaths out of thirty-one cases collected by Liebermeister, and three out of seventeen collected by Murchison.

While the slowing of the circulation is given as the direct cause of the formation of thrombi, changes must be established in the endothelium before coagulation can take place. To reiterate then, the general causes of a thrombosis are those which produce an abnormal condition of the endothelium, with a rapid destruction of the white blood corpuscles or a stagnation of the blood. In a phlebitis resulting from typhoid fever, or the puerperal state, the morbid condition of the endothelium proceeds without doubt from

\* Delafield and Prudden, "Pathological Anatomy and Histology."

† Loomis, "Practice of Medicine," page 678.

‡ Pepper, "System of Medicine," Vol. I., page 294.

an infection. These changes in the endothelium may be set up in the first instance by the action of the typhoid bacillus directly, or from the absorption of toxic substances which are produced as a result of the life processes of the bacteria at the point of their greatest accumulation and activity.\* Infection from the pyogenic cocci produce many of the inflammatory complications.

In the puerperium the morbid changes are without doubt set up by the absorption of septic material.

Thrombosis usually occurs during the third and fourth week of typhoid fever, sometimes earlier, and the veins most usually affected are the femoral and the sinuses of the dura mater. Their formation is attended with a rise of temperature and increased prostration. With thrombosis of the femoral vein there is pain and tenderness along the course of the vein and edema of the leg.

In establishing the electrical treatment of phlebitis there are two things of importance to be considered: First, the nature of the pathological changes within the vessel itself, *i.e.*, the presence of vegetations, or possibly of a thrombus along the course of the vein, as well as the presence of inflammatory exudates, more or less well organized, according to the duration of the disease, not only in the coats of the veins, but also in all the tissues of the legs; and second, to the selection of a current, which from its physical properties and physiological action will best combat this pathology without producing untoward results.

It is only necessary to refer to the role of muscular contraction and its effects upon the circulation to appreciate why it is necessary to avoid the use of any measure that will tend to produce abrupt muscular contractions, as, for example, with the disruptive discharge from an influence machine, or the sudden excitation characteristic of the slow interruption of an induction coil.

It goes without saying that the fast interruption of an induction coil is not to be thought of as that produces a tetanoid contraction, that tends, with its prolongation, to exhaustion of muscular structure. It is necessary to select a current capable of producing chemical changes, electrolytic and cataphoric, stimulating at the same time the circulation and increasing the activity of the

\* Delafield and Prudden, "Pathological Anatomy and Histology," p. 248.

† Delafield, "Lectures on Practical Medicine and Pathology."

absorbents, in order that the part may be freed as far as possible from the products of inflammatory action.

Physiological experiments show that even with a persistent closure contraction of the continuous current, and with fixed electrodes, rhythmical contractions are established which, for example, during a closure of from one to two minutes, are less (two to three) with weak currents, and more (five to seven) with stronger currents, and the interval at which the waves followed varied between four and twenty seconds.\* This is true not only of cardiac but of smooth muscular structures and under certain conditions of striated skeletal muscle as well. While it is true that in all quickly reacting and quickly conducting contractile substances the effect of excitation as is expressed by change of form is most marked when the current is made or broken, there is no doubt that the electrical current during its entire closure produces changes in the irritable substance, fundamental on the one hand to excitation, and on the other to antagonistic inhibitory processes.<sup>†</sup>

With a closure contraction such as would be maintained in the treatment of phlebitis, although these rhythmical contractions are going on throughout the interpolar circuit, there is no sudden violence done capable of loosening any fringe-like vegetation or thrombus, for that matter, from the wall or along the course of the vein itself. But by the action of the current a stimulus is imparted to the circulation establishing relief from blood stasis, and the return of fresh arterial blood to the part, while from the nature of their anatomical distribution there is imparted to the absorbents a continuation of this stimulus resulting in increased functional activity.

With the establishment of improved circulation, the danger of an obstruction to the venous circulation is minimized, and the indication for the application of a current capable of producing gross muscular contractions in addition to the physical and physiological action of the continuous current, can be safely met. The selection of that current must be made with the form of its graphic curve and its time rate in view. It must have an unvarying rate of change and a graphic curve capable of producing long, wave-

\* Biedermann, "Electro-Physiology," Vol. I., p. 197-198.

† Biedermann, "Electro-Physiology," Vol. I., page 318.

like and undulatory muscular contractions capable of doing work in the tissues without violence to them. The sinusoidal current, because of the perfect equality of its negative and positive variation fulfills these conditions best.

In cases Nos. 2 and 3 the continuous current was used, supplemented by the sinusoidal. The indifferent contacts at first were made by placing the foot of Case No. 2, and the feet of Case No. 3 in a warm saline bath, 1 per cent., T. 100 F.; while the active contact, an ordinary hand electrode, was carried to and fro over the surface of the entire leg, especially along the course of the veins involved, by the operator. Later on in the course of the treatment the indifferent contacts were placed in both cases over the lumbar enlargement and to the lumbo-sacral plexuses, in order that the stimulus might be applied directly to the origin of the nerve supply. This is preferably the correct technique.

"The fact that every nerve fibre is naturally connected with an organ of excitation, and a peripheral organ renders it impossible that any direction of conductivity other than from the former to the latter, should produce a recognizable effect." \*

The indifferent contact was connected to the positive pole, while the negative pole became the acting one of the conducting circuit because of its well known action upon inflammatory exudates. In the first two or three applications a dose of eight milliamperes was used. The greatest care was taken not to break contact at any time during the treatment, that sudden contraction of the muscles might be avoided. When this is carefully done there is no muscular movement save such as is characteristic of a persistent closure contraction, as is demonstrated by the absolute steadiness of the milliampere-meter needle. If this fluctuates the fault lies with the operator. The immediate result of the first treatment in both cases was an improvement in the circulation, evidenced by a disappearance of the tension and dull purplish color of the skin, and also by the softer and more yielding character of the tissues communicated to the examiner's hand.

In the third case a localization was made over the area of former ulceration, with the hope that the tissues might be more nearly restored to their normal integrity, as by the chemical action

of the current, an excess of fluids and salts so necessary to the nutrition were thus brought to the part with the flow of fresh arterial blood.

Daily treatments were given at first, lasting ten minutes. The dose was gradually increased from the minimum, eight milliamperes, to ten, fifteen and finally twenty milliamperes. Beyond this it was not necessary to go. The average E. M. F., as indicated by the volt meter, was twenty volts. In both cases there was steady improvement. After four days the continuous current was supplemented by a sinusoidal of low frequency in order to secure muscular contractions at about the normal rate of muscular response. In these, as in all other applications, the sinusoidal current was regulated with very great nicety through a controlling resistance, and applied with the same care as the continuous current. The arrangement of the electrodes was the same in every instance, and the time of application for the sinusoidal current varied from three to six minutes for each leg for the patient in whom both legs were affected, and from six to ten minutes for the patient in whom only one leg was involved. The contractions thus set up were profound and far-reaching in their effect, but of a gentle undulatory character. Treatments were given daily for the first eight days, and after that from three to four times a week, while later on but two and then one application was made during the week. The treatment was discontinued after three and one-half months in the second case, and after three months in the third case. Improvement established with the beginning of treatment was maintained, characterized by a more nearly normal circulation, increased elasticity of the walls of the veins, disappearance of the exudates, infiltrating and binding down the tissues, and diminution in size. In the second case, after one week's treatment, the patient who had been unable to walk, stand, or take physical exercise, played golf for the greater part of a day, and walked ten miles during the progress of the game. On the following day, at the conclusion of his treatment, he remarked that so far as feeling was concerned he could discern no difference between the two legs. The stiffness in the knee disappeared under the first treatment. In the third case the same progress was made as in the second, with improvement of the circulation from the beginning, especially marked by

contrast about the area of former ulceration on the right leg. In the course of the first ten days to two weeks this patient reported his ability to get around much more quickly and accurately ; that whereas in moving about before he was very clumsy, handling himself with difficulty, he was then able to move about in a perfectly normal fashion.

After the first ten days to two weeks' treatment the stockings were removed, gradually in the beginning, that is, for part of the day and after a few days entirely. At the end of a month both patients were advised to supplement their treatment by bicycle and other exercise. As in all chronic cases the improvement in the beginning was much more marked than subsequently, due to the chemical action of the current upon the less fully organized products of inflammatory action.

A much longer time is required to secure a marked effect upon the more fully organized products which, because of further pathological change, are less susceptible to the action of the current. For their removal persistent and frequent applications are necessary. Improvement continued, and at the end of three months' treatment both men said that they appreciated very little difference from the normal save that prolonged exercise produced fatigue more quickly than formerly. The second patient is now able to ride a bicycle from nine to twenty miles without any trouble, and both report that they have ninety per cent. better use of their legs than when treatment was instituted.

Early in August case No. 3 had an attack of rheumatic sciatica from which, however, he promptly recovered under appropriate medication and electrical treatment. Upon recovery he began taking exercise much more actively than had been possible since his attack of typhoid, rowing, swimming, playing tennis, walking, etc., and decreased his weight twelve pounds in two weeks. While he was much better for this in a general way, there was too great a strain upon the right leg and a considerable transudation took place in the lower two-thirds of the leg, especially along the tibial border and about the ankle. The fluid, as well as the discomfort caused by its presence, disappeared immediately after treatment, but returned at night after being on his feet.

The elastic stocking for his right foot and leg was again

resumed, and after three successive treatments the swelling had entirely disappeared, and at this writing (September 11th, 1898) the patient is entirely comfortable, but remains under care.\*

At no time since removed has the elastic stocking been resumed in case No. 2.

Such are the results obtained after the pathological changes had existed for thirteen and fifteen months, respectively. If these patients had been placed under skilled electrical treatment in the beginning of their trouble, before the products of inflammatory action were organized, much more complete restoration to the normal would have been established.

It is impossible for pathological changes to go on so long as in these two cases without there being an effect upon the lumen of the veins themselves, with loss of elasticity, which would have been obviated by early treatment.

In the first case, owing to a lack of time on the part of the patient, the treatment was established by the means of the Franklin current. Here there was a roughening of the inner coats of the vessel as well as a recent thrombus,<sup>†</sup> and the greatest care was taken that no fragment from the roughened portion of the endothelium or coagulum should become detached and allowed to drift into the circulation.

Bearing in mind the cardinal principle in the treatment of phlebitis, viz., that the form of electrical energy used should be expended in such a way as to avoid sudden and violent muscular contractions, therefore a careful localization with the convective discharge was made to the lumbar and sacral plexuses and to the entire surface of the affected leg, while the disruptive discharge was used for the opposite leg and the upper extremities.

It must not be lost sight of that with the convective discharge it is possible to do work in the tissues without gross muscular activity as a manifestation. "When we connect a sphere to a terminal of an electro-static machine having an electro-motive force of say 200,000 volts it will receive a comparatively large quantity of electricity which will be a certain fraction of a coulomb. Suppose the charge connected to the sphere be 1-1,000,000 of a

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\*Treatment discontinued in September, and patient well when heard of three months later.

coulomb delivered at a pressure of 100,000 volts. In that case the work delivered to the sphere would be equal to 0.1 of a joule, or 0.738 foot-pound. This energy is received by the air and ether surrounding the sphere and held there during the maintenance of the charge. It is distributed through the room although not equally. A certain fraction of a joule is charged in each cubic inch of space, the greater amount being in the immediate neighborhood of the sphere and lessening with the distance from the same."\*

"Just the same thing happens with the patient on the insulating platform connected either directly or indirectly with the prime conductor. The air and ether about him receive the energy and the work in this instance is delivered to the patient, representing work of so many foot-pounds or fraction thereof according to the electro-motive force and coulombs furnished. The charge is passed into the ether by electric displacement. This takes place along defined lines or curves which are called lines or curves of electrostatic flux."<sup>†</sup>

It will readily be seen, therefore, that there was work done in the tissues of the affected leg of definite foot-pound value although there were no muscular contractions set up. The patient gradually improved, so as to be able to walk more and more from time to time, and finally to dispense with his cane, and when last seen, some months after the discontinuance of treatment, he was very well and had had no further trouble. The progress was not so rapid nor satisfactory as in the other cases, however.

This paper is presented with the hope that it will call the attention of the general practitioner to the value of electrical treatment in phlebitis, and the necessity for its early application. The treatment should be instituted in the subacute stage if non-suppurative, by means of the most careful administration of the continuous current.

By the cataphoric action of the current the transudation, characteristic of a beginning of inflammatory action, can be overcome, while the establishment of circulatory changes and increased activity of the absorbents renders it impossible for exudative

\* "Electricity in Electro-Therapeutics." Houston and Kennelly.

† "Franklinization as a Therapeutic Measure in Neurasthenia." By Margaret A. Cleaves, M.D., *Journal American Medical Association*, November 14th, 1896.

material to be thrown out, either on the inner coats of the vessels, externally, or, as ultimately happens, in the tissues surrounding the vessels. In the early stage a minimum expenditure of energy only is indicated, and the dose should not exceed five milliamperes, while a fraction, to a single milliampere may suffice. The same care, and even greater, should be taken to prevent violent muscular contractions as has been pointed out in the treatment of chronic phlebitis. For the treatment of these cases, as in all medical work for that matter, the controlling resistance should be arranged in shunt, and an absolutely accurate instrument of precision used to measure the dose. From the results obtained in the management of exudative inflammations, the opinion is justified that if these cases are skillfully treated in the acute or subacute stages there will be a lessening of the disabilities incident upon the products of organized inflammatory action.

## New Uses of the Undulatory Current in Gynecology.

By G. APOSTOLI, M.D., Paris, France.

The undulatory current, until then unwritten about, has been the object of diverse clinical researches by me since 1896, and more particularly on gynecology since April, 1897.

The result of these researches has been communicated from time to time in several notes read at the Society of Electro-Therapy of Paris, July and October, 1897, and to the Academy of Sciences of Paris, and to the Medical Congress, at Moscow, July and August, 1897, and finally my student and assistant, Dr. Marquez, has made this the subject of his inaugural thesis before the Faculty of Medicine of Paris.

It is a view as a whole of these diverse works that I come to present to-day, as also the conclusions to which more than a year of practice has led me.

### A.—PHYSICS AND PHYSIOLOGY.

The alternating sinusoidal current apparatus of Professor D'Arsonval permits, by a very simple arrangement, to obtain a current of the same form, but without change in direction. We have then an electric wave starting from zero, the intensity of which goes on increasing to a maximum to redescend again to zero; a new wave follows after, but this wave is in the same direction and not reversed, as in the alternating sinusoidal. The whole produces itself in a regular and geometrical curve.

From these properties from the physiological point of view certain special qualities are derived, which we may sum up as follows; the undulatory current associates, one might then say, the effects of the galvanic to those of the interrupted current, but this interrupted current being a sinusoidal current and not a faradic current.

We have thus an electric wave, not alternating, striking always in the same direction, and continuing endowed with electrolytic

properties ; but at the same time it is a wave more mild and less brief, less irritating to the nerve and to the muscle.

Without entering here into the study of the characteristics of neuro-muscular excitation studied out by D'Arsonval, I will simply say that with equal force the sinuosidal currents are better tolerated than the faradic.

It is in basing myself on this characteristic of the undulating current, association of a polar electrolytic action of a constant direction to a variable state having a special curve, that I have applied this new electric mode to general therapeutics, and particularly to gynecology.

#### B.—METHODS OF USING.

Uses have been made of it in two different ways : 1st, In the first the active electrode was placed surrounded by moist cotton into the interior of the vagina. 2nd. In a second way this electrode formed a uterine sound of platinum being put in full length into the very fundus of the uterus, or only into the cervical canal.

In the two procedures the indifferent electrode, positive or negative, according to the case, is formed by a cake of clay spread out on the abdominal surface.

The seances, generally daily for the vaginal and every second day for the intra-uterine, were for an habitual duration of five minutes. The minimum dose varies from 15 to 25 milliamperes\*—1,800 to 2,500 periods per minute ; the minimum voltage was from 15 to 25 volts. D'Arsonval's apparatus allows of modifying the curve in effect, either in augmenting its height—voltage ; or in augmenting the number of alternating periods—number of turns of the dynamo.

For the polarity the indications are the same as for the galvanocautic ; in a general way we used the positive as a decongestant and the negative as a congestant. The seances are well borne ; the patient feels only a sensation of formication or of abdominal bubbling. Sometimes also during the first seances she has some painful cramps of the muscles of the anterior wall. In a general

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\* In two hysterics, by exception, we have attained without difficulty 60 milliamperes.

way women prefer the undulatory to the galvano-caustic or to faradisation.

After the seance there is no abdominal pain, but there is frequently a sensation of general lassitude, with a tendency to sleep during a few hours, as after physical exercise a little active, We have not in any case observed reaction having any intensity in the fourteen months during which this work was done.

#### C.—SYNOPSIS OF THE CASES TREATED.

During the fourteen months—March, 1897, to May 1st, 1898—there were employed at my clinic, under my direction, by my assistants, Marquez, Laguerriere and Guillemonat,

1,843 vaginal applications,
751 cervical       "
628 uterine       "
20 urethral       "

forming a total of 3,242 gynecological applications of the undulatory current. These diverse treatments were done on 228 patients, of whom 45, on account of different circumstances, were treated for too short a time (less than three times), so that account should be kept of them. There remains to us then 183 observations from which we can draw conclusions, and that I will review in the following table :

1. *Uterine Fibroma*, 88 cases.—Symptomatic cures or notable ameliorations, 46 ; good stationary conditions, 16 ; doubtful results, 12 ; no amelioration, 14.

2. *Diverse Lesions of the Appendages*, small cystic tumors peri-uterine exudates, some of which in the acute stage with fever, but we never treated cases with purulent collections, 18 cases.—Cures or notable ameliorations, 11 ; doubtful, 4 ; nothing, 3.

3. *Pelvic Neuralgias*, without lesion, or with insignificant lesions, 12 cases.—Cures or notable ameliorations, 4 ; doubtful, 2 ; nothing, 6.

4. *Metrites, Endo- and Para-metrites*, 42 cases.—Cures and notable ameliorations, 27 ; doubtful, 7 ; good stationary condition, 2 ; nothing, 6 \*.

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\* In three of the cases there is reason to suspect incipient carcinoma.

5. *Vaginitis and Vulvitis*, 5 cases.—Cures and notable ameliorations, 2 ; doubtful, 1 ; nothing, 2.

6. *Diverse Prolapses*, uterine, rectocele, cystocele, etc., 5 cases.—Notable ameliorations, 4 ; nothing, 1.

7. *Menstrual Troubles*, nervous, and from infantile uterus, 5 cases.—Notable amelioration, 3 ; doubtful, 1 ; nothing, 1.

8. *Hematocele*, 3 cases.—Cures, 2 ; doubtful, 1.

9. *Various*, 5 cases.—Pseudo tuberculous peritonitis, marked amelioration, 1, hysterical (?) with an annexial tumor.

Cystitis, intense, probably nervous. Cure, 1.

Cystitis by compression, fibroma. No result, 1.

Painful pregnancy, considerable amelioration, 1.

Metrorrhagia sine materia, 1 ; rebellious to all treatments, and cured spontaneously and immediately by a return to her native country.

#### OBSERVATIONS RELATIVE TO THE STATISTICS OF THE UNDULATORY CURRENT IN GYNECOLOGY.

1. As to fibromas and prolapses, the results given are results purely symptomatic without any reference to anatomical modifications.

2. The patients cured and the patients notably ameliorated have been considered *en bloc*, the patients considering themselves as cured when they were in a state which varied for each one of them according to her calling, her habits, her nervous state, and the state of her previous health to each patient considered.

3. The doubtful results are those of the patients who have interrupted the treatment soon, having experienced from a small number of seances but a slight result, or who have undergone at the same time other diverse treatment (other electric methods, antisepsis, etc.) which does not permit to report the ameliorations to the influence of the undulatory treatment.

4. Those patients included under good stationary condition, "Bon état stationnaire," are those which much ameliorated by previous treatments, but not cured (fibromas, chronic metrites, etc.), are in good health on condition that they are treated from time to time at separate intervals ; for them the treatment undulatory produced the same results as the treatments previously used (galvano-caustic and general intra-uterine).



An attentive study of the successes and failures obtained in the 183 cases has permitted us to make the following observations :

#### D.—THE SYMPTOMATIC RESULTS.

*Intermenstrual Pains*, abdominal, lumbar, inguinal, crural, rectal, etc.—The undulatory current is a powerful analgesiac, generally the patients experience from the very first seances a sedative effect, and a disappearance, more or less prolonged, of the pains which soon become defined. It is against these phenomena of pain that the indulatory current produces the most marked, most rapid and the most constant of its effects. At the same time, it must be pointed out that its action remains fairly localized, it is thus that for the greater part of the time epigastric pains, umbilical neuralgias, have not been notified under its influence. On the other hand, in certain hysterical pains the undulatory current has failed entirely, and in these cases it has seemed notably inferior to faradisation or to the static spark, agents more brutal but giving more energetic results.

*Dysmenorrhœa*.—In nearly every case dysmenorrhœa has been manifestly influenced by the treatment, and the patients have derived a marked benefit from the seances held during the inter-menstrual period ; but after a few months of practice, when we were convinced of the innocuousness of the undulatory current, we have systematically employed this current daily during the whole duration of the menstrual period, and patients who up to then had been obliged every month to have recourse to morphine have passed their menstrual period without suffering, and have been able to continue their habitual occupation.

The indulatory current then, calms dysmenorrhœa, and it calms it the better the closer to the period of menstruation, and much better during the course of it. Unfortunately its calming influence seems almost entirely temporary and it is but after a great number of sittings that definite results are obtained.\*

\* In the painful menstrual symptoms or inter-menstrual, in a general way, yet not constantly, the energy of the effects obtained has been more marked with intra-uterine than with cervical, and with intra-cervical than with vaginal, leaving out those cases where sounding was painful in itself, prevented at the commencement at least, that the intra-uterine applications should have had their full effect.



*Hæmorrhages.*—With vaginal applications, especially of feeble intensity, we have observed an augmentation of the existing hæmorrhages or the return of former losses. This fact, which we had already observed in 1892, for the sinusoidal current explains itself from the insufficiency of the interpolar action and the absence of polar action. (The vaginal protected electrode).

At a stronger dose, and especially from intra-uterine applications when we permit the undulatory current to produce all its effects, we obtain in a great number of cases a marked influence on the hæmorrhage. This influence, nevertheless, remains notably inferior and less sharply constant than that of the galvanic current, at least when we carry in each one of these cases the intensity up to the maximum of tolerance. Exception should be made for cases of metritis following parturition or miscarriage, they have been very manifestly and very rapidly benefited by the undulatory current. The hæmorrhages due to these affections have ceded from the very first seance, as happens on the other hand with faradisation and the sinusoidal.

*Menstrual Irregularities.*—At the end of a certain number of treatments the menstruations have regulated themselves ; they have come at more regular intervals, the flow has produced itself more clearly ; it has been less long ; has been subject no longer to interruptions and returns ; there has been less tendency to intermenstrual losses ; on the other hand, it must be said that these results have not always been constant, have shown themselves variable from one patient to another, and sometimes to the same patient, according to different circumstances.

*Amenorrhœa.*—The application of the negative undulatory has shown itself manifestly inferior to the galvano-caustic, which remains until a new order of treatment, the choice for this symptom.

*Leucorrhœa.*—As for the symptom, hæmorrhage, the results have been variable and very much less marked than with the galvano-caustic. It is but rarely that the vaginal applications have a marked effect, on the contrary with cervical applications, and especially uterine, the results without equaling those of the galvanic current have been more satisfactory.

Let us note for memory's sake that in a few cases during the first seances of intra-cervical applications we have seen a passing increase of whites.

*Constipation.*—We know how frequent constipation is in the woman, and especially in genitopaths. The undulatory current has nearly always, but still not in an absolute manner, brought about a notable amelioration or a cure. Without it being possible for us to say which is the method that gives the best results against this symptom, still intra-uterine or cervical applications seem to act more favorably than the vaginal ones.

#### E.—ANATOMICAL RESULTS.

We have systematically left out in all our experimentations the neoplasms, with the exception of the fibro-myoma (especially the uterine carcinoma and ovarian cysts) and the suppurative peri-annexial collections, considering them as treated justifiably only surgically.

Of the cases we have treated we may draw from an anatomical point of view the following conclusions :

*Fibromata* are not influenced in any notable way if in certain rare cases we have noticed a slight diminution of the tumor, in other cases on the contrary equally rare we have noticed an augmentation, from this point of view the undulatory is certainly very inferior to the galvano-caustic.

As for *periuterine exudates* their evolution has been accelerated and considerably favored by the undulatory, under its influence their resorption has effected itself rapidly, and we have seen the thickenings disappear and even the adhesions (be it well understood, before they have become completely constituted and not yet passed into a state of fibrous tissue).

*Endometritis* very favorably influenced in a general way have been but feebly modified when they were clearly purulent and manifestly infectious.

As to affections of the tissues of the uterus itself, they have shown variable modifications, now the ameliorations have been almost as marked with the galvanic current when the lesions have been simply congestive ; again, on the contrary, they have not been influenced when they had arrived at an advanced stage, in particular we have never observed with the undulatory the rapid resorption of hypertrophied cervices in chronic metritis, resorption so remarkable with the galvano-caustic.

The *Malpositions of the Uterus* (versions, flexions, prolapse) have not been anatomically modified to an appreciable extent, more often we have obtained the symptomatic cure (the symptoms of which the patient complained being most frequently not at all in proportion to the intensity of the lesions), but there is but a small number of cases where there is a modification of the positions of the organs under this heading an efficacious medical treatment remains to be found.

*Uterine subinvolution* in the cases treated has been rapidly ameliorated and the uterus regained in a few seances its form, its volume and its normal consistence.

It is impossible in an article such as this to base one's self on observations ; the reader may refer himself to the thesis of Dr. Marquez, which contains fifteen complete observations, specially chosen to place in relief the diverse properties of the undulatory current. I shall content myself then to publish here one case, which shall permit of verifying a number of our assertions.

#### F.—OBSERVATION (No. 12, OR MARQUEZ'S THESIS).

*Summary.*—Interstitial Fibroma, absence of resolutive action from the undulatory current on the fibroma, analgesic action of the undulatory current on the menstrual pains, marked action of the intra-uterine applications on the dysmenorrhoea.

Marie G., 44 years, no profession. Acute articular rheumatism at 17 years. Menstruated at 18 years, regularly and without dysmenorrhoea.

In 1893 and 1895 metrorrhagia lasting two days.

Since then menstrual periods have become longer and of greater abundance.

Treated in 1895 by a physician who gave her two lumbo-abdominal galvanizations, four galvano-caustic intra-uterines and static baths during three months. At the end of these three months the patient had a return of the metrorrhagias. In the month of August, 1896, retention of urine. Catheterization had to be done during five days.

Since then has vesical tenesmus and some difficulty in urination. Condition of the patient on entry to the clinic of Dr. Apostoli for metrorrhagia, which had lasted since February 4th :

Severe lumbar pains, rectal tenesmus, vesical tenesmus, a difficulty in urination, and a sciatic pain in the left side. Flowings (menstruations) abundant, with many large clots and lasting eight days. The menorrhagia and the dysmenorrhœa are so severe that the patient is obliged during the whole menstrual period to remain in bed.

*Diagnosis* on March 18th, 1897.—Interstitial fibroma especially prominent on the posterior aspect and of which the upper border reaches midway to the umbilicus. The fibroma is slightly fixed in the pelvis ; no pain on lifting it.

The cervix is atrophied. No lesions of the annexes.

*Electrical Treatment*.—On March 19th the first seance of the vaginal galvano-caustic (35 milliamperes) without any result.

On March 22nd an intra-uterine galvano-caustic application was made for the first time of the strength of 45 milliamperes and the sound introduced six centimetres. The hæmorrhage stopped after this seance.

From March 24th to April 9th there were made six galvano-caustic intra-uterine applications of an average intensity of 70 milliamperes.

During this period of treatment the patient had no more abundant metrorrhagias, but she continued to lose nearly every day a few drops of blood, and the lumbar pain, the vesical tenesmus, the pains during micturition did not in any way become less. Slightly less rectal tenesmus.

The menstruation that came on on April 4th, after the fifth seance, was normal in quantity, but was accompanied by violent lumbar pains.

On April 10th we commenced vaginal treatment with the undulatory current.

The five first treatments done from April 10th to 16th provoked a general lumbago, a marked fatigue, a marked tendency to sleep and some nausea.

All these phenomena became less and less from the fifth treatment, and at the same time as the lumbago became less the pains of micturition and the vesical tenesmus diminished in intensity.

On May 10th (after fourteen vaginal treatments with the positive undulatory current of an average intensity of 15 milliamperes) we observe that :

1. From April 10th to May 10th the patient had not had since the beginning of the treatment any metrorrhagia, no sanguous loss between the menstrual periods
2. The rectal tenesmus completely disappeared.
3. The vesical tenesmus, the dysuria, the pain at the moment of micturition have been diminished.
4. And again, the patient finds that her abdomen is much less tender on palpation. But the patient menstruated on April 20th, they were abundant and there were many clots.

From May 10th to 15th two more undulatory vaginal treatments were done. The benefits already attained maintained themselves in their entirety.

On May 15th, with the idea of combating the dysmenorrhoea which had persisted right up to this time, we commenced the positive intra-uterine undulatory.

From May 15th to July 10th we did this treatment fifteen times, using an average intensity of 20 milliamperes. During the two months that the patient underwent the intra-uterine undulatory all the painful symptoms were notably diminished :

- 1st. The lumbar pains were manifestly diminished.
- 2nd. The rectal tenesmus already overcome by the vaginal treatment did not return.

3rd. The vesical tenesmus, the pain and the difficulty at the moment of micturition were still more diminished (still the menstrual period was always accompanied by more or less dysuria).

4th. The sciatic pains diminished in intensity and frequency, but we should mention the undoubtedly action that the ten inter-current treatments of high frequency exercise on the sciatic pains.

5th. No metrorrhagia.

6th. The menstruations have been less abundant, without clots, and less painful. The constipation was not affected.

On November 28th, 1897, and May 27th, 1898, four months and a half and ten months and a half after the cessation of the treatment, the patient came to see us at our request, and she stated to us each time :

- (a) That she had no more lumbar pains.
- (b) That the rectal tenesmus had not returned.
- (c) That her sciatic pains had not reappeared, except during a couple of weeks in November, and then were much less intense.

(d) That the vesical tenesmus and the difficulty of urination, though much lessened, still persisted.

(e) The dysmenorrhoea had not reappeared. The patient, who before the commencement of the treatment was obliged to remain in bed during the whole menstrual period, has been able to go out and walk about during the menstrual period. The periods always last from four to six days, but are much less abundant, and there are no clots.

(f) No metrorrhagia during July and August, but during the whole of the month of September the patient lost always a few drops of blood whenever she went to stool. No metrorrhagia during October or November.

*Last Examination, May 27th, 1898.—Anatomical condition same.*

Though the fibroma seems less high up than at the beginning, it reaches to a point below midway between the pubis and umbilicus.

Always absence of tenderness. No appreciable difference on vaginal examination. Same atrophy of the cervix. Same prominence of the fibroma in the *cul-de-sac*. Same sub-peritoneal nodules.

The uterus as a whole is more easily elevated and displaced than at the beginning and appears to have more apparent mobility, which is a characteristic of the anatomic amelioration acquired.

*Conclusions.*—Here, then, is a fibroma which anatomically does not seem modified and still has its symptoms ameliorated, and not in a temporary way either, but permanently; since ten months and a half after the cessation of the treatment, the amelioration has persisted almost entire.

This observation shows us that the previous dysmenorrhoea has disappeared and has not returned up to this time, and that the benefit acquired from the point of view of the cessation of the inter-menstrual pains has not yet in any way become less. The metrorrhagia alone has had one severe return during the month of September.

The clinical evolution of this case shows then from one side, the absence of a resolution influence of the undulatory current on fibroma; but, on the other hand, it gives us the extent of the analgesic power, immediate and extended, of this same current on the symptom, pain, whether menstrual or intermenstrual.

#### G.—CONSIDERATIONS ON THE EFFECTS OF THE UNDULATORY CURRENT.

If it is difficult, in the present position of physiology, to explain the effects, and especially the effects of an electric current, it is yet possible to discuss at least on broad lines the clinical results so far observed. The undulatory current we have seen is endowed with an electrolytic power ; but, on the other hand, on account of the variation in the conditions of the patients being able to support intensities not exceeding 25 milliamperes. It is evident in this fact that we find the explanation of the superiority of the galvano-caustic in the cases where they show themselves more efficacious. In fine, when we wish to obtain electrolytic polar actions, whether escarotic and caustic (uterine haemorrhage) or antiseptic (purulent endometritis), or when we wish interpolar trophic effects, the explanation of which still remains to be found (fibroma, metritis), it is natural that an electric method of which the applications oscillate between 80 and 150 to attain even 200 milliamperes in certain cases, is much superior to a procedure permitting intensities very much less strong. We see, after all, a confirmation of this way of seeing in this fact than in haemorrhages, endometritis, etc., vaginal applications of the undulatory, that is to say, applications stripped of all electrolytic action have shown themselves of very little efficacy, whilst in certain cases we obtained marked results on placing an uncovered metallic pole in the uterine cavity.

It is equally to the difference of intensity that should be attributed the inferiority of the negative undulatory compared with negative galvanization against amenorrhœa. On the other hand, if it is inferior to the continuous current, the polar action of the undulatory is not to be despised, since this treatment has shown itself certainly superior against leucorrhœa and haemorrhage to the sinusoidal, which as to curve is exactly alike ; then where the sinusoidal or the vaginal undulatory brought back the haemorrhages the intrauterine undulatory never gave rise to a return of this symptom, and often it has shown itself efficacious against it when it existed.

On the whole, this new electric method may be employed with

results in all those cases of average gravity amenable to the galvano-caustic, where currents of feeble intensity seem sufficient. But from the side of its electrolytic power it possesses a new property, a variability of state having special characters of mildness and of uniformity.

It is to this property that we should attribute the other effects of the undulatory, in particular its analgesic property, its decongestionating action, its influence on the resorption of exudates. There is there then its vasomotor action that we must take account of, which stimulates the circulation, and as a consequence modifies the blood stagnation and stimulates the disappearance of effusions and oedemas. Its toni-muscular which favor the emptying of natural cavities (uterine clots, salpingitic products, etc.) helps to combat congestive phenomena at the same time that it causes to regress uteri in subinvolution, or even, in certain cases, remedies position causing ligamentary contractility to come into play. At the same time there is an action on the nervous element that must be taken into account, effect produced by the rapid oscillations analagous to that of vibratory massage. Again, it is evident that in very many of the cases the two properties electrolysis and variability superpose their effects, and that, for example, to obtain decongestion, there is every reason to add the action of the positive pole to that of the vibrations. As to saying, if there is only a superposing, if one seance of undulatory is identical to one of galvanization of equal intensity, followed by an application of sinusoidal of the same voltage and of the same number of periods, or if from the association of the two terms there result new properties, that is impossible at the present time, the first hypothesis seems the more probable.

#### H.—GENERAL CONCLUSIONS ON THE POSITION OF THE UNDULATORY CURRENT IN GYNECOLOGY.

Whatever, after all, the procedure by which the undulatory produces the constant results, that which it is possible to affirm is that this new current possesses properties of its own and is called on to take an important place in the therapeutics of gynecology. It is true it does not dethrone either of the two great methods known up to the present, the faradic and the galvanic, and we can even

add that for the practitioner engaged in employing these two therapeutic measures the undulatory is probably an arm not indispensable.

But it will be of an incontestable utility in all those cases when there is a reason to associate the effects of the continuous and the interrupted currents. It is evident that the undulatory cannot pretend to dethrone the galvanic as a cauterizing agent for mucosa (haemorrhage) nor as an antiseptic (infectious endometritis); its electrolytic action at the doses in which it can be employed is insufficient for that. It cannot either rival this current in its trophic action against the evolution of fibromata. But by its prominent action against pain it will be used with the best results in all cases when there is reason to bring about an analgesic action when other symptoms do not demand a current of higher intensity. It is thus that it should be recommended in non-purulent endometritis and in painful fibromata, feebly haemorrhagic and of slow evolution.

Again, for intense hysterical pains it should often cede to faradisation (or to the static spark), but, being better tolerated than the last, it should be preferred to it in all cases where there is cause to draw use from a variable electric state; in this case after all, it is better to use the undulatory than its congener, the sinusoidal, on account of the superadded polar action, a feeble action it is true, but which might be useful under a great number of circumstances. It is thus that for subinvolution, prolapse, uterine malpositions and especially congestions, stases, peri-uterine and peri-annexial exudates, it seems to be the treatment of choice.

As to the cure of acute inflammations, during the febrile period, for all that we have had no inconvenience in its employment, our experiments have been made on too small a number of cases for it to be possible at the present time to pass any definite judgment or to say if it has any property surpassing those of the other electric methods used cautiously and in small doses.

In any case, I think I have in the preceding conclusions, expressed exactly what, after fourteen months of practice, my experience permits me to hope of this new procedure. It is, I think, one more arm to be added to the procedures of conservative

gynecology, and if it does not permit after all to extend in a marked fashion this field, it will, at least, often aid in the production of a cure more promptly and more easily in certain of the affections already amenable to other electric procedures.

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#### DISCUSSION.

Dr. G. BETTON MASSEY, of Philadelphia, Pa., said, regarding the treatment during the inter-menstrual period, that it was possible that Professor Apostoli had borrowed a thought from him. Some years ago he had called attention to this matter in a paper read before the Philadelphia Obstetrical Society, and he was thoroughly convinced that these patients could be saved much drugging and pain by an intra-uterine application at the time. In these cases it would be invariably found that the uterus is open, and a physician making such an application he thought, would not be inclined in the future to place much reliance upon the mechanical theory of dysmenorrhoea.

## Electricity in the Treatment of Uterine Fibro-myomata.

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By FELICE LA TORRE, M.D., Rome, Italy.

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In a work of mine in course of preparation "On the Indication for Hysterectomy for Fibro-myomata, and on the Treatment of these," I set myself against the destructive gynecology become today barbarous and inhuman through the enormous number of hysterectomies which it practices, without any precise indication, as was called barbarous the obstetrics of past centuries because, ignorant of many points, it was formed on the basis of tenacula and grappling irons, sacrificing an excessive number of women and babies.

In this work, after having passed in review the actual condition of the question, I ask : What are the indications for the extirpation of the myomatous uterus ? To be able adequately to answer this question I say it is appropriate to study first the question from a series of points of view ; that is to say, to see :

1. What is the nature of fibro-myoma ?
2. What modifications can fibro-myomata undergo ?
3. What is the utility or less of the myomatous uterus in regard to the woman, the family, society and science ?
4. In what do the dangers of fibroma consist ?
5. Whether there are means for dissipating them and which may in some cases relieve us from going on to destructive action ?

I show that myo-fibroma is of a benign nature, and that it can be modified by degenerating, very rarely, into sarcoma, never into cancer—only at the most co-existing with this, and that rarely. Other modifications to cause fibrous bodies to acquire characteristics clinically malignant are oedema, gangrene, inflammation, cystic degeneration, morbid entities very rare, and fatty degeneration—this a modification rather beneficent and salutary.

The greatest danger through which fibro-myoma becomes a malignant morbid entity it acquires by reason of the haemorrhage which it sometimes occasions and which can be overcome. Now, we are not authorized to extirpate the myomatous uterus in all cases

without taking account of the age of the patient, of the interests of the family, of society and of science, because when the fibroma presents no complication, when it is small and does not produce pains, when it is subperitoneal and does not produce haemorrhage, the neoplasm does not hinder fecundity, sterility being in myomatous uteri in the proportion only of fifteen per cent., while sterility from other causes is thirteen per cent., and even when the tumor is in the pelvis and voluminous it does not hinder the normal development of pregnancy and the natural or artificial completion of the birth, to which there are often attached immense interests of heredity, etc. It is clear that if myo-fibromata be very large, producing acute sufferings, haemorrhage repeated, obstinate and refractory to every kind of treatment, which have degenerated or become associated with cancer, and which, altering the disposition of the woman, render her really ill, etc., etc. It is clear, I say, that in these cases extirpation of the myomatous uterus, a source of danger to the safety and even to the life of the patient is indicated, will indeed be necessary ; it is needful to destroy.

But under any other circumstances a myo-fibroma, not being a neoplasm of a malignant nature, and it being possible to cause it to disappear or arrest its progressive evolution, overcoming even haemorrhage, we owe the greatest respect to the myomatous uterus ; since, in extirpating it without necessity, we destroy the woman. The woman is destroyed, who lives entirely in the sentiment of maternity and family. She remains only a virago, a neutral individual, often sad and malign, a kind of monstrosity of the species, defiled, who vegetates *Velut pecora quæ natura finxit prona et obedientia ventri* (Like cattle whom nature has formed with the head downwards and in obedience to the belly)—and more than cattle, often a hyæna, a viper, like the holy women castrated for moral reasons through the falsehoods of a degenerate faith, because it is not true that in the faith of Jesus Christ the sentiment of maternity is excluded.

We have instead, means natural and artificial to render less, or cause to disappear, myo-fibromata, and to cure their symptoms. The natural means are : First, the menopause which, by suppressing the menstrual flow, causes in the greater number of cases the arrest or even the involution of the neoplasm, whatever may be thought or said to the contrary,

Secondly—Pregnancy, which determines in the myoma a fatty degeneration, causing it at length to disappear.

Amongst the artificial means or amongst the remedies of which we make use there figure in the first rank as solvents of myomata, ergot, mineral waters and electricity. And here, permit me to pass in review the part which the electric current has in the treatment of fibro-myomata of the uterus.

#### ELECTRICITY.

Electricity is one of the most potent means which modern therapy employs in the symptomatic treatment of uterine-fibromata and in such sense gynecologists make use of it to-day.

Pozzi, in fact, says that the preponderance of observers recognize that electricity diminishes visibly the haemorrhages and pains by improving the general condition. He gives the opinion, therefore, that without falling into the exaggeration of Thomas Keith, who characterizes as a delinquent every one who practices hysterectomy without having first tried electricity, one must remember that this constitutes a therapeutic resort which it is no longer permitted to neglect in cases in which it would appear that an operative procedure would not give good results. Bonnet and Petit write, on their part, that electro-therapeutics renders good service on condition that one does not demand of it more than it can give. Electricity does not cause a fibroma to disappear, but it is certain that one often obtains suppression for a greater or shorter period of the haemorrhage, alleviation of the pains and of the phenomena of compression, sometimes an arrest at least temporary of the enlargement of the tumor and even a certain diminution of its volume. It is a valuable means, they continue, in the cases of interstitial or submucous neoplasms when operation is not accepted or is contraindicated.

Other authors are averse to electricity—more correctly, do not accord to it any therapeutic value—amongst whom I am sorry to have to note two illustrious masters and very dear friends, Martin and Durante, and whose opinions I must combat through that respect which we all owe to truth.

Martin, apropos of the means for arresting haemorrhage, says : “Numerous papers have been recently written on the treatment

of myomata by means of electricity. I do not possess on this point personal documents. I have made, however, with V. Robenan, when he was my assistant, very exhaustive electric experiments in the case of carcinoma. The complete want of success of our experiments has made me renounce all further attempt." Curious! The haemostatic action of electricity in haemorrhagic fibromata is judged by experiments with it in cases of carcinoma. It does not seem true.

Durante writes : " Finally, Apostoli, modifying somewhat the method of application, brought back into an honorable position electrolysis, formerly employed with disputed success in fibromata of the uterus and in other tumors. I, after having used it largely in my clinic and outside, had not the fortune of having the results of which the author and some others boast. Its efficacy, even as a haemostatic measure, to me is very doubtful." Prof. Durante then, speaking every year of uterine fibro-myomata, criticises sharply the method of Apostoli, and says, in support of his conviction, that his colleague, La Torre, fresh from Paris, having asked to practice the method of Apostoli upon patients in the clinic had not obtained the desired effect ; that is, of seeing the tumor disappear or the haemorrhage arrested. Well, the assertion of my very dear friend, Professor Durante, is to be cleared up a little. The use that I made of electrolysis in Durante's clinic refers to one single case, which really deserves a notice for the edification of the readers.

It refers to a young Sicilian, of about 28 years, marriageable, a confidante, rather than a servant maid, in a rich family, of exaggerated religious sentiments, a kind of a household nun, of which there are many in Sicilian families, suffering from a large uterine interstitial fibroma.

Her menstrual losses are somewhat profuse during six or seven days, soiling from fifteen to twenty cloths, but what more torments the patient is a white discharge of the most abundant kind, against which she has to protect herself as against blood. The patient used to say : " After the blood I lose in a white discharge for about fifteen days, and I am not free between blood and white discharges except for a few days." She is on this account somewhat anaemic and debilitated, and thence more agitated and excited in her religious sentiments. She enters the clinic to undergo hysterec-

tomy, but I having arrived in those days a votary from Paris, Prof. Durante does me the honor, for which I render him infinite thanks, of trusting to me the patient to try electrolysis. There was a great ado to persuade the patient to allow the electrical applications to be made, and at last it was commenced ; but having to maintain every time a regular struggle to cause her to put herself in the proper position, which conflicted with her religious sentiments and fearing the scorn of the people of the hospital.

However, I applied several times the electrical current, some ten times, and I can certify that the white discharges, above all the predominant symptom, had almost completely ceased for some days, and the menstruation which came on during the treatment was much more regular, in contrast with the preceding ones. This was verified principally by Dr. Bonanno, the first assistant in the clinic. Meanwhile the patient slept better and ate, thus contributing moreover to her nutrition. After some time that she was in the hospital the patient, weary and annoyed and maintaining that exposing herself to such kind of treatment constituted a real sin, wished to leave the hospital and go to the house of her patrons on the pretext of solemnizing a family festival, but with a firm resolve not to submit herself any more to electrical treatment, and she wished to know nothing more of it. Furthermore, taking as a pretext a menstruation, abundant, haemorrhagic, as was said, she decided suddenly to undergo the extirpation of the myomatous uterus. Prof. Durante, meanwhile, not taking any account of the results obtained as shown by the symptoms, looking for the disappearance of the tumor and not seeing it, addressed himself to the operation and performed it with success.

The extirpated myomatous uterus having been split open, there was found a large interstitial fibro-myoma of the fundus of the uterus, and the tumor being split open it was seen that fatty degeneration had commenced at the periphery of the neoplasm, whilst there was in its centre an irregular cavity about the size of a hen's egg filled with a kind of reddish slime. This uterus is that same one which I presented at Berlin. This is the fact.

Does this authorize one to say that, after the experiments made by La Torre, electricity does not deserve any esteem ? To me it seemed not. Again, we must think a little of one circumstance.

The action of ergot to determine the involution of neoplasms is more certain and more positive than that of electrolysis. Well, for what length of time must one use the said drug? For one, two or more months, says Durante. And does he then expect to obtain the same result with a few seances of the electric current? That is not possible without remarking that no one any longer thinks nowadays of claiming that electrolysis absorbs fibro-myoma. It would, moreover, be expecting the impossible at least nowadays. Another accusation that is made by many against the Apostoli method is that it is not a haemostatic measure; but, in order to say that, it would be necessary to be certain that the method is conscientiously applied, observing not only the most minute but also the most obvious rules.

Now I have seen, for example, used by some, a copper uterine sound instead of a platinum one. Such an instrument is not good, because, being oxidized under the action of the current, it wastes the electric fluid. Some other times they have not made use of the galvanometer, which represents the scales in the administration of poisonous remedies, so that they have not any idea of the amperes of fluid used, which may be too many and hurtful, or few and useless. I have seen applied for the treatment of a metritis the method of Apostoli, with a copper sound and without a galvanometer, the operator perceiving, after the sound had been in the uterus ten minutes at least, that the battery was not working. Once a colleague applying electrolysis without a galvanometer had to administer such an enormous quantity of amperes that he produced most severe pains and caused a metritis.

All these little mistakes, of no moment apparently, may, on the contrary, have very great weight in the final results. Those, then, who say that electrolysis is of no haemostatic value ought first to be certain that all the apparatus is in proper shape, and this, in most instances, is not observed.

In view of this contradiction in the interpretation of the action of electricity, I, in order to be able to say something truly exact and more opportune to this subject, turned to my friend and very dear master, Dr. Apostoli, the man most competent to deal with this subject, asking him to tell me something apropos. He was a gentle saint to answer me, and here is the note which he sent me,

which is truly the last word on the condition of the question, cutting short the misconceptions which yet remain regarding the electrical treatment.

"Surgical intervention," writes Apostoli, "in uterine fibromata, consisting ordinarily in hysterectomy, certainly, in some cases, becomes inevitable; but it should remain always as a last resort, the *ultima ratio*, after all the means have been tried which conservative gynecology offers. We think that after a profound study of uterine fibro-myoma, of its characters, clinical and anatomo-pathological, of its evolution, of its relations to general and local nutrition, we ought to arrive at a therapeutic conception more rational, less brutal in its procedures and in its results, taking into much more consideration (much better than a grave operation such as hysterectomy does) personal dangers and social interests."

"The greater number of the women affected by uterine fibro-myoma present often another hereditary antecedent, and almost always another personal antecedent, arthritic manifestation, that is to say, a vice of general nutrition.

"Also locally there are met disturbances of circulation anterior to or following the fibroma, which have, as a consequence, favored its development.

"In these conditions it does not seem that gynecology has a better aid than electricity, and particularly the galvanic current.

"Electrization of the tissues by means of the continuous or galvanic current, practised according to the rules of well defined technique, which has already given good account of itself, will have as a result the modification of the circulation, the stimulation as a consequence of the nutritive functions and the diminution through this of the actual disturbances of which the principal is haemorrhage. Furthermore, electricity opposes itself to neoplastic formation, which is in course of development.

"From this it is seen that electrical treatment, though it be palliative and symptomatic, and without having any claim as an absolute radical cure, can nevertheless, when it is practised scientifically for a sufficient length of time, bring about a lasting benefit. It is also seen from this that the electrical treatment of fibromata ought not to be considered as empirical practice, but indeed as a method which is founded on the teachings of physiology and general pathology.

"By means of electrical treatment, of which the employment is simple, easy and within the grasp of all medical men, for the application of which a very costly and complicated armamentarium is not necessary, when there are kept in view the precise rules which I have formulated in regard to the duration of the application, in regard to the sensation of the current, the intensity which, even where strength is required, ought also to be subordinate to the degree of tolerance, the following results will be obtained :

"1. Diminution, then cessation, of the haemorrhage, and as a consequence regulation of the menstrual functions in sixty to seventy per cent. of the cases.

"2. Regression or disappearance of the peri-uterine exudates in forty to seventy per cent. of the cases.

"3. Diminution and suppression of the painful phenomena in fifty to sixty per cent. of the cases.

"4. Partial but not constant regression of the neoplasm in ten to fifteen per cent. of the cases.

"5. Improvement of the general health, which may be obtained directly (action on nutrition) or indirectly (resulting from local improvement), in sixty to seventy per cent. of the cases.

"We have not finished enumerating all the services that can be obtained by the employment of electricity in connection with the subject which occupies us.

"In the cases of intra-uterine polypi galvanization generally favors the formation of the pedicle (see La Torre) and contributes as a consequence to facilitating its final extraction.

"Moreover, galvanization is not only a therapeutic agent, but is also, occasionally, in cases of inflammation of the adnexa, a valuable diagnostic element, since the phenomena of the action will indicate that purulent collections exist.

"In resume, I will say that electric therapy remains still, notwithstanding its numerous theoretical detractors, of whom the greater part have not given themselves the trouble of making proof of it, the rational treatment best suited to uterine fibromata. It has in view the procuring to the woman a comfort, a well-being which she has a right to claim and hope for, conserving an organ the removal of which often causes, besides personal dangers, considerable losses to the individual from the point of view of general health.

"That which constitutes in all cases a real loss to the family and to society it is well to note it, electrical treatment does not cause, as numerous cases show, namely, sterility. And in cases in which surgical intervention cannot be practised, electrical treatment will serve to bring relief to the afflicted.

"So also in the cases in which the electrical treatment remains inefficacious, the patients will always have as a last step the resource of resigning themselves to surgical intervention, which has become inevitable, and then perfectly legitimate and justifiable.

"Finally, in conclusion, I say that the practitioner wishing to treat a uterine fibroma, ought before any other medication to counsel and use the electrical treatment, that is, galvanization, if it were for no other reason than as a simple touchstone."

In such manner then, electricity acts on myo-fibromata.

It may be said that the electrical current determines, in small degree it may be, a fatty degeneration of the myomatous elements; in fact, I was able to present at the Congress of Berlin a myomatous uterus removed by Durante from a woman whom I had subjected to a few electrical seances (Apostoli method). On the microscopical examination of the tumor, it was seen that the neoplastic tissue was commencing to undergo in its external submucous layers a fatty degeneration.

If the treatment had been continued, might it have been possible for the degeneration to have become more extensive and to have, as a consequence, a diminution and disappearance of the fibroma?

Certainly not. It must be said, to be honest, that the myomatous uteri subjected for a long time to electrical action are now quite numerous, and the hoped for diminution or disappearance is far from the reality, and no one seriously thinks any longer of applying electricity to bring about the involution of the neoplasm. But the galvano-caustic being able to cause the menstrual flow to cease, we have an induced premature menopause, and then, for this reason, indeed, a reduction in volume of the dimensions of the neoplasm.

Has such reduction been due to the absorption of the degenerated muscular elements? Is it a consequence of the absorption of the exudates? of the shortening of the uterine fibres? I do not know?

It would be well, I said at Berlin, that, in view of this question, if it were possible, all the patients in whom hysterectomy for fibromata is judged necessary should be placed for some time under the action of electricity, so as to be able to establish scientifically the action of electricity on the neoplasm ; but too truly my recommendation has remained in the condition of a pious desire, no thought ever having been given to the study of this scientific point in the pathology of fibromata, nor is there hope that such study will be made. Hysterectomy, too truly, will not make science progress regarding this point.

The means, then, for treating and even curing uterine fibromata are in existence, and can very well, nay, they ought often, to do away with the performance of hysterectomy.

In this very brief examination one can affirm that the alleged transformation of fibroma into cancer is shown, by unanimous consensus of surgeons and of facts, to be rather a theoretical view than a possibility to be realized at least, as a scientific morbid entity, the only thing possible being the association of cancer and fibroma; that the sarcomatous degeneration which may more readily take place is also very rare, and can very well be diagnosed clinically (there being very marked characteristics, especially in the course of development, between the two diseases) and can be foreseen in good time ; that the other general modifications, such as gangrene, oedema, slough, suppuration, as well as accidents, such as torsion of the pedicle, adhesions to neighboring organs, compression, etc., which occur ordinarily when fibromata are very large, are rare eventualities, and do not come on so rapidly as to kill the patient without giving us the necessary time to free her or to render less destructive the consequences of the complications, of which some are very often salutary for the patient, and deserve sometimes that their appearance be hailed with joy.

There ought also to be taken into consideration as an exceptional sequence to the natural menopause, that the conditions of fibro-myoma become worse whilst its benefits and those of gestation, of ergotine and of mineral waters, ought to be considered almost the general rule.

Immense and salutary is then the action of electricity as the symptomatic treatment adapted to overcome the frequent and most

dangerous symptom of fibromata—haemorrhage, which by its gravity gives more than anything else the clinical character of malignity to fibromata, besides electricity being able to determine the spontaneous expulsion of fibrous bodies and rendering them more accessible, and thence more readily removable.

In fine, electricity, it may be helpful to repeat, lessens the physical sufferings by calming pain, restores strength, improves the nutrition, and supports the spirit and the *morale* of the patient.

Already reaction against the *puritis operandi* arises majestic and bursts forth already from the manly breasts of our illustrious masters ; D'Antona, Durante and others amongst us already limit enormously the hysterectomies. We are at the first rays of dawn, and I hope that the day will soon arise, and may the sun, fruitful of good intentions, soon illuminate the minds of surgeons to follow the masters in the certain operative procedures that *unus post unum non remanebit unus !*

Whatever may be, finally, these considerations of mine, even not taking into account the clinical contribution which I bring, they are always to my mind reasonings which cannot fail to impress the minds of all honest and good-hearted surgeons who interest themselves in the true measure of well-being to women in regard to the family, to society and to science. To these, animated to this noble and inspired purpose, my homage !

## Electricity Employed in Gynecology.

By GEORGES GAUTIER, M.D., and J. LARAT, M.D., Paris, France.

Properly speaking there does not exist a special proceeding of electricity for treating diseases women are subject to. The practitioner must know how to use methodically the different electric modalities in this kind of disease. Those who wish to treat rapidly and advantageously gynecological affections, must as well state their diagnosis as make a judicious choice of the best electric form for every special case.

Simple or metallic voltaic chimicausty, the undulatory alternating currents, induced currents of tension and quantity, form a powerful therapeutic arsenal, the resources of which must be used in a varying order, with a force, a continuance and a repetition, the rules of which must be known in order to be able to state approximatively the effects.

Positive voltaic chimicausty with platinum or carbon electrodes is rarely applied, and putting aside the internal treatments of the brain, it would be prudent to reject localisations in the uterine cavity, which, not being of any superior effect, may provoke serious accidents even with the most skilful practitioners. Voltaic peri-uterine chimicausty, on the neck and vagina, applied according to the severe method of asepsis, continuance and intensity, has the best results. This kind of localisation condemns at the same time high intensities. Any electrode serving vaginal applications must be aseptic and very well protected by hydrophile wadding, so as to avoid mortifications of the mucous membrane, which is in contact with it ; it might even be removed during the sessions. These latter may last from a quarter to half an hour ; the intensity must not surpass forty milliamperes. Positive metallic voltaic chimicausty is only useful if intra-uterine. Cupric chimicausty, superior to other varieties, finding the maximum of its influence in the lesions of form, nutrition, irrigation and infection of the uterine mucous membrane acts by secondary electro-chemical compounds without doing harm to the constitution of the uterine mucous lining, avoiding posthumous effects consecutive to voltaic,

inoxidable, positive chimicausties ; mortification and suppuration. Undulatory alternative currents render excellent service to the gynecologist, which we have made known as soon as we had introduced them into therapeutics. Their applications in the localised or generalised form are of good effect on the constitution, on circulatory troubles, and those of menstruation, and we must remember to come back to these applications in treating fibromas and chronic endometritis. Then by stimulating general nutrition, acting on intestinal indolence, emaciation and nervous depressions, they re-establish in the majority of cases the weakest organisms. Associated to the inductive currents of tension they are also applied to pains in the small pelvis, in peritonitis (pelvic exudates), the dissolving drainage of which may be operated by this means.

Currents induced in small quantities, in monopolar vaginal applications, with few interruptions, very bearable intensity, a long session, constitute the best treatment a medical man has in hand, to struggle with advantage against metrorrhagias, the development of fibromas, endometritis and the abdominal surplus of fat.

The facility of these applications and the advantage of the implements have made us understand still better the entire usefulness.

## Treatment of Uterine-Fibroids by Small Currents Administered Percutaneously.

By R. J. NUNN, M.D., Savannah, Georgia.

It may be set down as a principle in medicine that, other things being equal, in the treatment of disease that particular system is the most useful, can be applied successfully to the greatest number of cases, and will be employed by the largest number of physicians, which is the safest and the least complicated, requires the least expensive appliances for its thorough and effective application, the least delicate and intricate apparatus, the least amount of technical knowledge, skill and experience, and is withal the safest.

Between the physician practising in a large city, in charge of a large hospital, and his brother toiling and struggling in the rural districts, there exists a very wide and important difference in the responsibility which attaches to each, as to the result of his treatment in the cases submitted to his care. To the great hospital surgeon with a wide reputation and a large *clientèle* the loss of a few cases is a matter of but small moment, unless by some unfortunate accident they should happen to be persons of distinction and prominence in the world, and even in that case the responsibility is generally shared by a number of consultants, whose personal influence and professional reputation are in each case the equal of his own at least.

In this case everything is available which science can suggest and wealth can supply—trained assistants, skilled, watchful and experienced nurses, the very latest and most improved mechanical appliances, irrespective of expense ; of medicines, just the remedy required is at hand and available, quite regardless of cost ; the strictest hygienic surroundings can be maintained ; the diet can be regulated to a nicety ; and altogether nothing is wanting that human skill can suggest or that money can supply to make success almost a certainty.

If, in spite of all these advantages, a patient high in rank and of wide acquaintance and reputation should fail to recover, no one thinks of blaming the doctor, or of attributing the fatal result to

any fault on the part of the medical attendants—the well-known skill and the vast experience of the physician precludes the possibility of any mistake having been made in the diagnosis, or of any course of treatment having been adopted but that which was absolutely correct. In fact, the simple name of the physician is an ample assurance that everything within the range of human possibility had been done for the patient, and nature, or the patient has to take the blame for the fatal result. “The operation was successful, but the patient died.”

Turn we now to “the common country doctor.” In common with the majority of his clients, he makes but a scanty living, nor is he, or are they, blessed with a superabundance of the goods of this world—whatever may the amount of the store be which they have laid up in that land “where rust doth not corrupt.” No skilled nursing is at the command of our country brother. He must be content to put up with that furnished by the family and friends of the patient, or else he himself must act as nurse. This he not unfrequently does, but this must detract from his ability as a physician in a greater or less degree, for with a body fatigued with physical work and with a brain worn out with watching, to which must be superadded the exhaustion which necessarily accompanies the manifold cares and perplexing anxieties which unavoidably come to all practitioners, but bear most heavily and most tellingly upon the truly conscientious physician—thus burdened, it becomes a matter of impossibility for him to bring the highest of his mental powers, the deepest resources of his diagnostic skill, or the best results of his experience to bear upon the case immediately under his care.

Hygiene is not unfrequently an unknown quantity, and diet is quite beyond his control as regards either quality or quantity. Trained assistance he cannot have, but must content himself with the willing but unskilful help he finds around him.

With all these drawbacks, the responsibilities of the country practitioner are further intensified in proportion to the ignorance—and, it might with justice be added, the superstition—of the community in which he practices, or of the friends and family of the patient under his charge. The results, to him, of success or of failure are immensely disproportionate. The successful issue of

his treatment brings to him, in all probability, but little pecuniary reward and less fame. But in the case of failure, there is no stint of blame. Then, indeed, the truth of the saying will be forcibly impressed upon him, "A time is served to every trade, save censure. Critics are all ready-made."

As the case slowly fails, there are the consultations of all the know-all's and wiseacres of the neighborhood. Every old woman and most of the old men have as many "sure cures" to suggest as there are speakers, and *post factum* prophets, with their eternal "I told you so!" spring up at every corner. In case either of failure or success, almost the sole reward the doctor can expect is the consciousness of having done his duty.

Under these circumstances, amid such surroundings, it may well be imagined that the great bulk of the profession will eagerly accept any method of treatment which, even if not so brilliant, so rapid in its results, or so dazzling to an unprofessional audience, has in it the inestimable merit of safety.

Let it not be supposed that the patients will always accept the slower and safer treatment in place of the more rapid and more dangerous alternative. "Fashion in physic" demands and receives quite as much distinguished consideration and the same humble obedience which is accorded to it in the other walks of life, where it governs with an equally tyrannical rule.

In the discussion of this curious phase of medicine there will present itself to the accurate observer of this class of patients a remarkable but very widespread characteristic, which, while a well-recognized factor and a cultivated quality in many other conditions of social life, is here productive of very unexpected and singular results. It is a desire to be the first and the most distinguished among one's fellows. A particular patient of this class tells in vivid language of the character of her malady, of the sufferings she endured and of the extensive operation of which she was the subject. Her fellow-sufferers, either present or prospective, look upon her with respect, with awe and with admiration; she becomes to each of them a heroine and an object to emulate, or, if possible, to excel; and so each lives on in the fond hope that she also may some day be able "to have an operation done," and so be enabled to tell her story to an admiring, sympathizing audience.

Since the introduction of normal ovariotomy, the number of abdominal sections has fearfully and unwarrantably increased.

There are surgeons, who eagerly seeking the very flimsiest pretext to justify themselves in "doing an ovariotomy," seize the opportunity of ablating the ovaries lest at some time in the remote future they might become diseased. This surgical mania, this *cacoethes operandi* has had no little material offered up at its shrine by a class of females who are desirous of avoiding the perplexities, annoyances, inconveniences and sacrifices necessarily attendant upon the care of children. To such an extent had this evil gone that one of America's most renowned gynecologists published a letter in one of the medical journals in which he said in effect that, "having a clinic as large as any in the great metropolitan city in which he resided, he had, during the past year, seen but three cases in which he could conscientiously advise an operation, and in one or two of these even he was somewhat in doubt as to its absolute necessity, and hence he failed to understand how it was that gentlemen with not one-sixth of his opportunities could find operations by the hundreds."

Up to a certain time gynecologists seem to have overlooked that the object of all medical interference should be "the restoration of normal functional activity to diseased or disordered organs." They appeared to have forgotten that destruction, mutilation or ablation is not cure. But the pendulum of fashion is now swinging in the direction of conservatism, so that even small uninfected pieces of diseased ovaries have been left in place, so as to retain, if possible, the normal function of the organs.

The action of electricity in this connection may be either destructive or catalytic. The destructive action of electricity is manifested upon the use of large currents, the application of as much as 1,000 milliamperes having been reported to this association. It is evident that applications of currents of this character can be made only for short periods and at long intervals, for in no other manner can the destructive action of the current be controlled. The immediate and subsequent effect upon the patient are exceedingly painful, the pain often lasting for a week or more; it, and the constitutional disturbance following the applications, in some instances causing the patient to abandon the treatment altogether,

or to seek relief in laparotomy, preferring in the one case to bear with the more tolerable torture of the disease itself, or in the other to run the greater risk of the major operation, rather than endure the repeated tortures accompanying the applications of this form of electricity.

The administration of an anaesthetic always carries with it more or less of danger and consequent anxiety to the practitioner, and the necessity of its administration during the use of the painful high current, must always prove an additional drawback to the use of high milliamperage by the general practitioner, unless indeed, a method should be devised by which the accompanying pain could be avoided. Some practical experiences on this latter subject may be taken up in a future paper.

Such are the immediate effects upon the patient of these cauterizing electrical currents. The general practitioner will always look at them askance because they must, or at least they should, forever remain in the hands of the specialists, of such as are equipped with the special education and experiences necessary to the successful application of this form of treatment, and having the apparatus which is indispensable in the administration of this form of the electrical applications. Thus it will be observed that this really valuable form of treatment has heretofore failed, and must always fail to reach the masses and to become popular among "the rank and file" of the medical profession.

But there is another method by which this agent can be applied for the cure of the diseases in question. According to this plan the use of electricity can be placed well within the reach of the masses, and for this reason at least this method should commend itself to the good-will of this association, in that its employment will tend to popularize the use of electricity, and raise it to a higher position in the estimation of the general public.

The method referred to, is that of employing small currents percutaneously. The theory involved in this system depends on the chemical or catalytic action of the current, avoiding altogether its cauterizing power.

It is a well-established fact in electro-physics that the amount of chemical change produced by a current of electricity is proportionate to its quantity, the velocity depending upon the time

occupied in the delivery of the specified quantity. There are, of course, certain modifying circumstances which come into play, but for all our purposes this rule may be accepted as correct.

For the application of electricity according to this method there is not the least practical necessity for any complicated or expensive apparatus; in fact, the whole necessary outlay, including fifty cells of battery and a rheostat, need not exceed \$25, and even this figure may be very much reduced if the physician has ingenuity enough to make his own rheostat and galvanometer.

Block tin is by far the best electrode, but in the cases here reported the electrodes employed by me were made of sheet lead, such as can be bought of any plumber, the softness and flexibility of which made it an easy matter to adapt it to the contour of the patient, while its weight assisted materially in retaining it in place and in making contact. Interposed between the electrode and the patient layers of wetted lint are to be placed, sufficient in number to insure the uniform distribution of the current, five, ten, fifteen or twenty of such pieces may be used, and these are preferably sewn up in bags containing each about five pieces of lint. It is needless to say that electrodes of as large size as possible should be employed.

The current was applied for from fifteen to twenty minutes at each sitting from an ordinary chloride of ammonia battery of about thirty cells.

A simple galvanometer, which anyone can construct for himself, with a fifty cent pocket-compass, or buy ready made at a very moderate price, may in this method well replace the more expensive milliammeter, because the galvanometer shows the flow of the current, and that is all that is of any practical value, as the quantity administered must be governed solely and entirely by the powers of endurance of the patient. Of course it is interesting as a piece of scientific information to know that one patient could bear one hundred and fifty or two hundred milliamperes of current on one occasion, and perhaps not one-fourth that quantity at the next seance. It sounds well in a report of cases, it gives a learned and scientific flavor to a paper, to give a detailed account of the resistances of the patient at each sitting as measured by a Wheatstone's bridge. This gives an appearance of great care being exer-

cised in the administration of the current, of close observation in the matter of detail, impresses the patient in a high degree with a great respect for the carefulness and learning of the physician, and mystifies her with the appearance of a long array of complicated instruments, but to no really practical purpose whatever. All of this will not in any way change the character of one fibre of the tumor, or introduce one element of safety into an already perfectly safe method of treatment, or simplify a system which has already been reduced to its simplest factors.

All the facts that it is essential to know are that the current is passing and that the patient is taking all she can bear without being burnt.

The investigations in this method of treatment began about 1880, and continued for about ten years, after which time another line of investigation was taken up. The results of the treatment have in all cases been satisfactory, nor is this statement at all untrustworthy in view of the fact that ample time has elapsed to enable the results to be checked by observation.

The formation of a tumor of the character under discussion is gradual, and such would be its method of disappearance were nature, unaided, to undertake its removal.

Evidently within a given time the powers of absorption of the system must have a limit, and if the products of electric decomposition freed exceed this amount, there must inevitably follow systemic disturbances of some kind, the gravity of which must be proportionate to the amount of decomposition products set free. From this it follows that the method of treating these tumors by promoting slow absorption is the most natural and the safest.

It may be assumed as a fact that the greater the solidity of a tumor the more difficult will be its electrolytic decomposition and its absorption, and any expedient which will tend to loosen its fibres, will facilitate the action of the decomposing current. It will be found, therefore, that the action of an occasional or simultaneous application of a coarse faradic, or other current causing contractions, will prove of value in these cases.

The method of application is as follows : The battery, the galvanometer and the rheostat being coupled up in series, the circuit is closed and the current turned on by the rheostat to see that everything is working properly.

If the apparatus is working satisfactorily the current is turned off and the electrodes are attached, one to each end of the combination, by cords of convenient length.

The patient being in the dorsal position upon a suitable table or couch, the wet-padded electrode attached to the positive pole is placed under the sacrum, the weight of the patient serving to retain it in position and insure contact.

The electrode attached to the negative end of the combination being covered with a sufficient number of wet pads is placed upon the abdomen, and may be retained in place by the patient's hands, which will also make sufficient pressure to insure contact.

If it is preferred to employ a band passing round the patient for the purpose of retaining the electrodes in position, it will be found that a large sponge placed under the band on the abdominal electrode gives a certain amount of elasticity which will prove convenient and useful.

It will be well to place a piece of india rubber gossamer under the sacral electrode and over the abdominal one, with some dry towels between the gossamer and the electrodes for the purpose of absorbing superfluous moisture. This arrangement will be found to thoroughly protect the patients clothing.

These arrangements being completed the current is slowly and cautiously turned on until it reaches the limit of the patient's tolerance, and is kept at this point for twenty minutes.

The galvanometer must be watched during the seance, and the rheostat may also require occasional attention.

The sitting being ended the current is turned off by means of the rheostat, the electrodes are removed, the damp surfaces on the patient dried, and she is dismissed until the next appointment.

The sole visible result of the application should be a more or less intense reddening of the skin which was covered by the electrodes. Should there be blisters, its an evidence that the contact between the skin and the electrode was imperfectly made, and each of these points should be protected by a bit of india rubber gossamer or a bit of adhesive plaster during each subsequent application until they are healed.

1. One of my earliest cases was that of a nullipara, in whom there was a fibroid the size of an orange. As this tumor was

discovered at the first examination of the patient, it is impossible to determine the age or the rate of increase of the growth. The constant current was administered through a large positive electrode on the sacrum and the negative on the abdomen, and the treatment was continued for several months.

Five years later this patient again visited me, having in the meantime resided in the West, the tumor was then much reduced in size. A few years later she died of pneumonia.

2. There was no element of uncertainty as to the rapidity of the growth in the case of a unipara, who, two years before had suffered from vesical catarrh, for which she had been treated by an eminent metropolitan gynecologist, who had made an artificial vesico-vaginal fistula, this he had not succeeded in closing entirely, for which cause she placed herself under my charge.

The gynecologist referred to told her at the time he examined her that she had no tumor, yet when she came to me she had a fibroid in the anterior wall of the uterus about two inches and a quarter in diameter. It is evident, therefore, that in this case there is indisputable evidence of the existence of a tumor of reasonably rapid growth. The line of treatment already indicated was pursued, the patient is now in excellent health, while the tumor shows a marked decrease in size.

3. An unmarried lady applied for treatment on account of an irritating vaginal discharge. An examination revealed a fibroid uterus rigidly bound down in anteversion.

She was subject to like treatment, and is now perfectly well as regards her general health, with rather a diminution of the tumor and a softening of the adhesions.

4. The next case to be presented is that of an uncomplicated fibroid in an unmarried lady who suffered but little inconvenience from the growth except in her increasing size.

Under treatment the increase of the tumor was arrested and she now suffers no inconvenience.

These four cases very well illustrate the effects of this treatment in an exceedingly common class of fibroids which produce but little constitutional disturbance, for which reason they have been placed in one group.

5. Pale and anemic, with marked weakness and dyspnæa, to-

gether with irregular menstruation, backache, sleeplessness, irritability and other nervous symptoms, an unmarried lady presented herself for treatment. Her abdomen was quite distended and was found to contain a fibroid uterus about five inches in diameter, apparently uniform in its general development. In reality this was a case of multiple fibroids, for after a few weeks' treatment, faint ill-defined lines of division could be felt, which, later on, became clearly marked, and three distinct tumors could be easily made out.

Slowly but perceptibly these swellings diminished in size, the patient's health and appearance approached their normal condition, and she now regards herself as well, although the tumors have not wholly disappeared, nor have they perceptibly increased in size since the discontinuance of treatment six years ago.

6. Practically bedridden for three years from the effects of a fall, an unmarried lady came under my care.

She had been having medical treatment ever since the time of the accident. "In falling," she said, "she struck her abdomen and since then had suffered great pain in her back and hips, owing to which she was compelled to remain in bed." An examination revealed an enlarged, tender, congested fibroid uterus, but whether the commencement of the disease could be attributed to the accident or dated from an earlier time, it was impossible to determine.

As the result of treatment continued for several months, the growth of the tumor was effectually arrested, and for years has given no trouble.

7. A multiparous married lady consulted me on account of her general condition, which presented an appearance of great gravity. She was generally swollen, jaundiced, of a dropsical appearance, and suffered from severe dyspnoea, loss of appetite and frequently recurring uterine haemorrhages. She was extremely weak and her abdomen was much distended. She was found to have a large uterine fibroid.

The treatment in this case was varied, in that, in addition to the mild percutaneous current, applied by my office nurse, the positive was applied by myself intrauterine whenever there was haemorrhage, but the frequency of the haemorrhages soon diminished, as did also their quantity, so that this portion of the treatment

was altogether discontinued. In this case the diminution of the tumor was quite remarkable, the patient gradually assumed her normal healthy appearance, and has for some years been attending to her household duties without inconvenience, regarding herself as perfectly well.

8. An unmarried lady of mature age presented herself for treatment on account of a swelling of the abdomen, which had increased to such a size as to be the cause of much inconvenience. Examination revealed the presence of a large tumor extending from the ensiform cartilage to the os pubis, and well over to the crest of the ilium on each side. The uterus was movable and the tumor, which was probably fibro-cystic in character, seemed to be attached to the right ovary.

Although treatment has been suspended for some years the tumor seems to have continued to diminish in size, and the patient is enable to pursue her ordinary avocations without inconvenience.

These cases are sufficient to demonstrate that the mild continuous current applied percutaneously has a wide range of usefulness. Most of the applications were made by a nurse who found no difficulty in carrying out the treatment to a successful issue.

Being absolutely devoid of risk, this method of the application of electricity to this class of diseases commends itself to the favorable consideration of the general practitioner everywhere, but more especially in the country districts where the services of a specialist are attainable, if at all, only at such a sacrifice, as to practically place them beyond the reach of many, perhaps the majority, of his patients.

Another, and not unimportant feature of this treatment which is of value to the physician as well as to the patient, is that it enables them to keep out of the clutches of these "medical sharks," who, be it said with regret, abound in all large communities, often occupying very prominent positions, but whose only object in life seems to be to advance their own interests, at the expense of the unfortunate patient who comes under their charge, or of the equally unfortunate physician whose reputation they do not hesitate to injure where the opportunity is afforded them, if, by so doing, they may perchance gain a little temporary but unmerited notoriety from a people, alas, too willing to be deceived.

Finally, in employing a system of treatment which is so closely allied to that which nature uses in the processes of repair, or of tissue-changes of any kind, it must be ever borne in mind that, equally in the patient and in the physician, two qualities are essentially necessary, these are Faith and Patience. Faith in the correctness of the guiding principles, and patience in their practical application.

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#### DISCUSSION.

Dr. G. BETTON MASSEY, of Philadelphia, Pa., said that the paper was good evidence that its author had lost none of his old-time energy. It is easier in hospital practice to take out those tumors by a cutting operation than to remove them by the slower electrical treatment. Nevertheless the results desired should be carefully kept in mind.

Dr. HENRY McCCLURE, of Norwich, England, said that he had listened with great pleasure and attention to the paper. It brought up the question of how electricity acts. We had been taught that it acts as a caustic, yet certainly the results obtained by Dr. Nunn could not be explained in that way. A number of years ago he had prepared a paper for this society, in which he had endeavored to explain the effect of dielectric strain. It had been proved that all opaque bodies in the physical world are conductors of electricity, and that all transparent bodies are non-conductors of electricity, or dielectrics. A current of electricity in passing through a dielectric changes its electrical structure; the electricity, as it were, becomes entangled in the dielectric tissue. In this way it is possible to understand that a compression may be produced in the uterus, and this may, in turn, lead to the production of a fatty degeneration.

Dr. Nunn said that he had scarcely touched at all in this paper upon the scientific side. The paper was intended to be purely practical, and to present to general practitioners a method which they could employ with success. In one of the papers already presented, it had been stated that there was no evidence of chemical action, yet at the *post mortem* examination he admitted

fatty degeneration was found. Tumors are amenable to treatment almost in proportion to their density. A very dense, hard tumor is hardly amenable to treatment, but if by any means one could loosen the fibre of the tumor, one could increase one's power of destroying that tumor. He hoped in the future to be able to present a paper demonstrating interpolar action.

Dr. McClure said that there were two theories—one mechanical and the other chemical. Electricity does not travel, but the electrical energy travels. His theory was that on the cathode closure the molecules are put on the stretch.

## **Menorrhagia and its Treatment by Weak Galvanic Current with Intra-uterine Positive Silver Electrode.**

By ADELSTAN DE MARTIGNY, M.D., Montreal, Canada.

I intend speaking of the increased flow of blood from the uterus at the menstrual period. Some menorrhagias seem to be idiopathic ; i.e., that they cannot be accounted for. Others recognize different causes, namely, endometritis (*fungosa hæmorrhagic*), inflammation of the ovary, fibroma, approach of menopause, sexual excesses and previous abortion.

Having to deal with one of these cases, and knowing for a long time that all medical treatments will fail, we have to choose between an operation (curetting), caustics and electricity.

Whilst the caustics are universally abandoned, and most of the gynecologists advise the operation, I claim that electricity is the treatment *par excellence*, if employed as the title of this short paper indicates; i.e., very weak current (three to six milliamperes), with positive silver electrode in the uterus. The treatment to be applied once or twice a week, in the intervals of the periods and during five to ten minutes at each seance.

We have all noticed how nervous and excitable are women suffering from menorrhagia, especially if young and having tuberculous family history ; and we all know how some of them are frightened at the mere word "operation."

In this respect electric treatment is specially advantageous as the nervous state in which these patients are, is very early modified for the better and soon disappears altogether ; and this especially if the first period, following the beginning of treatment, has been shorter and less abundant, as is the rule.

At once the patient begins to eat and sleep better, and even to prepare a programme for the next season, when two or three weeks previous she was talking of nothing but the securing of a place for her grave.

This indicates to you that I refer to severe cases of long duration in patients discouraged and exhausted, some of them having already been operated upon without results.

Some of the cases I have treated successfully had been declared hopeless. Others left to nature to cure themselves by the climacteric, if, however, the patient should not die in the meantime.

Of these severe cases, though young in practice, I have treated seventeen, which I will not report individually, as the time so occupied would be considerable and could, I think, be more usefully employed.

As a rule the second menstrual period, after the beginning of the treatment, is much improved, and the third almost normal. The treatment, however, must not be discontinued for one or two months more, but two or three seances a month are sufficient. For the next two months I also give electricity, but only once each month.

All cases, I must say, are not so quickly cured, and some have required a longer treatment, those especially caused by a small fibroma; but all have come to a successful issue. It is really gratifying to the gynecologist to see these patients coming to his office, each time with a better and more lively expression on their faces, and from the state of total discouragement in which they were, becoming thoroughly confident in the power of electricity which, to use their own words, "cannot be too highly praised." I hope none of you will bring up the question of "suggestion." Personally, I leave it aside.

A point which may be particularly noticed is that this treatment does not cause any pain. After the electricity has been given all that is necessary is that the patient should remain perfectly quiet for one-half hour to one hour.

The exact and intimate action of this special electrolysis has been discussed. The fact, that such a weak current should have such powerful action has led electricians to think that the results are partly due to the decomposition of the electrode and the formation of "oxychloride of silver," which is in itself a powerful astringent, and is supposed to be thus distributed over the internal surface of the uterus.

The fact that a platinum electrode does not give the same results would give some credence to this view, which I feel inclined to admit myself.

I must insist on the fact that, after four to ten minutes of posi-

tive current the uterine electrode becomes very dark and adherent to the mucous membrane. A negative current of the same strength as the positive is then required to free the electrode in the cavity. The negative current must be allowed to pass, not for five seconds or twenty, or any definite length of time, but "as long as the sound is not felt free in the hand of the operator." Then the current should be gradually shut off. The electrode is then and only then withdrawn.

The advantages of this method are :

- (1) Absence of danger.
- (2) Absence of pain.
- (3) No confinement to bed and consequent loss of time.
- (4) Constant good results, even when operations have failed.\*
- (5) The immediate tonic and quieting effects obtained.

These are the conclusions which I have drawn from a practice of less than four years, during which I have treated only seventeen cases. But all these cases were severe, some regarded as hopeless, and in all of them electricity has proved successful.

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\* This is proved by the last case I have treated. The patient had been operated upon twice in three months and a half without results and was constantly getting thinner and weaker, while under electric treatment for three months she has gained fifteen pounds and her last period was almost normal.

## On the Use of Cataphoresis in Certain Forms of Conjunctival Inflammation.

By LUCIEN HOWE, M.D., Buffalo, N.Y.

When the conjunctiva is in a normal condition, cataphoresis can be used if desired in the same manner as elsewhere, although the assistance rendered by the cataphoresis is seldom necessary.

It may be desirable under exceptional circumstances when, for instance, the conjunctiva being normal we wish to obtain more than the superficial effects of cocaine in order to remove a chalazion or other small tumor lying in the substance of the lid.

Under such circumstances, a drop of the cocaine solution may be applied to the eye in order to facilitate manipulation. After that, if the lid be everted and cocaine be applied on a positive electrode of suitable form to the mucous membrane and the negative electrode to the outside of the lid, it will then be found that the effect of the local anæsthetic is more thorough and more rapid than when simply instilled into the eye.

It is not often however that this is at all necessary, simple instillation of the cocaine being quite sufficient when the conjunctiva is normal. But in the majority of cases where it is desirable to apply solutions of cocaine or any other drug to the conjunctiva, we find that membrane already in a state of hyperæmia, sometime intense, or with oedema, and frequently covered with granulations. Thus it is the morbid, and by no means normal conjunctiva which most frequently greets the practitioner, and the question is how to cause solutions of cocaine or anything else to penetrate that engorged membrane. Now, we learned some time ago that if a solution of the extract of the suprarenal capsule be dropped into such an eye, that would cause a contraction of the engorged vessels within a few minutes. We learned, also, that when the vessels were thus contracted, solutions of cocaine and atropine were rather more readily absorbed. It is not easy to account for this in every way, but the fact remains. But unfortunately even with the aid of the extract of the suprarenal capsule it is often—very often—impossible to obtain the full effect of the solution of cocaine or euacaine.

Now, the principal point to which I wish to call attention is, that under such circumstances cataphoresis is of decided advantage not only when using the extract of the suprarenal capsule to reduce the engorgement, but also after that to apply the cocaine, or even for some of the drugs employed for these inflammatory conditions. That is, instead of dropping the extract into the eye, a much better effect is produced by applying it with a positive electrode of suitable form to the conjunctiva, the negative pole being on the outside of the lid. The current should be very weak, even a half of one millampere often giving decided pain.

The second point to which I would call attention is the form of the electrode. At first I used for the lid and for the globe the cup shaped electrodes, filled with saturated cotton. The disadvantages I soon discovered. Recently I adopted those more nearly spoon shaped—the concavity of the spoon holding the saturated cotton in a very thin layer, or saturated blotting paper, or even the solution alone. If the handle of the electrode is properly jointed, it can be conveniently held by the patient as long as may be necessary without discomfort or fatigue to him.

Finally, I would add a word concerning the general estimate of cataphoresis, or even electro-therapeutics in general, by some branches of the profession. Not long since when inquiring at the office of the Buffalo Dental Manufacturing Company for appliances for cataphoresis, the manager said, "We have one of those machines, but the demand is now so small for them, that we pay much less attention to their sale than formerly." Again, in conversation not long ago with a prominent gynecologist, who is himself the editor of a standard treatise on that subject, he said that at the last meeting of the American Gynecological Society, one member of that body read a paper which practically killed and buried electro-therapeutic treatment in that department, and two other papers followed which cast stones upon the coffin. If electricity in ophthalmology has not suffered so tragic a death, it has at least languished more and more of late years until its life is questionable. This apparently is the status, judging from the opinion of leading practitioners, expressed verbally or in their writings.

I mention this not to prove that the estimate is just, but that in some cases at least the failure is due to our ignorance. Of the dentists, for example, I found on further questioning the dealer

and one or two practitioners, that the cup electrodes were almost always employed, a form which, as Morton and others have shown, is often worse than useless. Moreover, some applied the current exactly as it should not have been done.

As for the methods of gynecologists or their knowledge in general of electricity I am unable to speak, but I suspect their qualifications in this respect are no better than that of the average ophthalmologist, and I do know those to be very imperfect. That may account in part for the average estimate of electro-therapeutics by some practitioners. A part also is probably due to the fact that miracles are often expected. But whatever may be the future of other branches of electro-therapeutics in the domain of ophthalmology, I am firmly convinced that cataphoresis at least will prove so useful in a certain limited class of cases that it must remain one of our reliable methods of treatment.

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#### DISCUSSION.

Dr. ROBERT NEWMAN, of New York, said that this was the first time in his life that he had regretted that he did not treat diseases of the eye. He would like to ask Dr. Howe if he had employed cataphoresis in cataract, and if he thought it probable that by cataphoresis cataract could be dissolved.

Dr. R. J. NUNN, of Savannah, Ga., said that he was deeply interested in the paper, although not engaged in ophthalmological practice, and he hoped the association would give a further opportunity to Dr. Howe to explain the details of his treatment.

Dr. MARGARET A. CLEAVES, of New York, said that she had utilized the cataphoric treatment with the oxidizable electrodes in conjunctivitis and trachoma, using silver, copper and zinc at the positive pole, and securing the transference of the nascent metal into the conjunctiva. In one inveterate case of trachoma, observed with her by a well-known New York ophthalmologist, a complete cure was obtained. In conjunctivitis the silver electrode always acts most charmingly, and even long-standing cases may be cured. A case of chronic parenchymatous corneitis had been treated cataphorically with mercury with marked improvement of vision, although the patient was still under treatment and was not cured. She had not used the sublimate in solution.

Dr. A. D. ROCKWELL, of New York, said that for a good many

years he had been accustomed to use a glass electrode filled with clay, and applied to the eye. By using a considerable strength of current he had seen good results follow. He could easily understand how thoroughly even the cataphoric effect must be when employed in the manner described in the paper. He had employed cataphoresis extensively in the removal of hair, and had found that by using cocaine cataphorically this ordinarily uncomfortable treatment could be applied without causing any pain. Recently, however, during the application of cocaine in this way the patient suddenly became unconscious, and was at first thought to be dead, although she eventually recovered. This had made him hesitate to use cocaine as frequently as formerly.

Dr. CLEAVES remarked that she had had a somewhat unpleasant experience from the use of cocaine in other ways, but never when employed cataphorically.

Dr. G. BETTON MASSEY, of Philadelphia, Pa., said that as Dr. Howe used a brass electrode connected with the positive pole, there was necessarily a cataphoric action of the brass in addition to that of the cocaine. He thought the use of pure mercury was preferable to that of sublimate solution. A gold needle may be amalgamated easily with mercury, and this furnishes a perfect electrode. Of course, a minute portion of gold would be introduced cataphorically, but the quantity must be very small with such mild currents.

Dr. Howe, in closing, said that with a lid of a certain thickness we did not know just what current was necessary to produce any cataphoric action that could be demonstrated. If we could obtain some ocular reaction, such as the formation of the iodide of starch, we could more nearly approach exactitude. In such directions as this must we look for advance. What was needed now was exact data as to what substances act by cataphoresis in a certain way, and under a certain current. He had attempted to pass iodine or starch into the globe of the eye and obtain the characteristic color. When it is applied over the cornea, there being nothing but aqueous immediately underneath, as soon as this flows out only a few drops are left. He had made several experiments of this kind on rabbits. Once in the human subject before removing an eye he had applied an increasing strength of current, even up to the point of producing an eschar, and yet no definite results could be observed. We must, therefore, depend for the present upon clinical data, no matter how necessarily imperfect.

## Electricity in Deafness and Strictures of the Eustachian Tube.

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By ROBERT NEWMAN, M.D., New York, N.Y.

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If specialists had a sure cure for chronic middle ear disease with deafness, this paper would not have been written. The usual routine of aurists keeps some patients deaf who would be benefited, perhaps cured, if electricity had been employed. In the month of April, 1868, I had a patient, Mrs. M. C., widow, who had been deaf for eight years. Several aurists of the highest standing found deafness due to cartilaginous growth over left tympanum, etc. The routine treatment did not improve her any. The writer was then induced by Dr. Neftel to give galvanism, which improved hearing considerably, so she could hear all noises and music in the street and conversation carried on only a little louder than normal; while she never was cured yet she was made comfortable, and in bright clear days could hear very well.

In February, 1874, she had a pain at the lower part of the humerus in bone and muscles.

March 27. At the dinner table, without anybody touching her, she felt a snap on the arm and a distinct, loud sound was heard by everybody at the table. One hour later the writer saw the patient and found a complete fracture of the humerus, which diagnosis was verified by authorities. A recovery and union took place in due time. She has had several ailments during several years and could hear pretty well.

About 1890 the deafness increased, and as she had not had treatment it grew worse, so that in 1896 she was almost as deaf as years ago.

In 1897 she grieved about the death of her daughter.

In April, 1898, she came again for treatment for aneurism of the brachial artery with distinct calcification and atheroma.

External galvanic applications, particularly over calcifications, had absorbed these calcifications and improved the circulation. She has not come regularly for treatment, but is materially

benefited, though not cured, and never will be. Galvanism has ameliorated her deafness so that for over twenty years she has been comfortable, but at the present time is very deaf again.

*Deafness Improved by Galvanism.*

Many years ago the writer used galvanism in different stages of deafness, and always on patients who were not benefited by specialists ; in fact, they were told that they were incurable. In some instances such patients told the specialist that the writer treated them with electricity, and received generally the answer that "electricity probably would not hurt them ; they may be amused by it." Those specialists were my friends !

Patients were always benefited by the galvanic applications and some very much improved. As all the patients were under treatment for other ailments, and the deafness treated only as an intercurrent malady, no regularly detailed notes have been kept ; but it is certain the electricity benefited, though given in an experimental manner. All these cases were treated during the period of 1868 to 1874, and are mentioned here only to show that electricity is a therapeutic measure which should be cultivated by the specialists. Progress has been made gradually and many benefits in this specialty have originated by the efforts of members of this society.

Dr. Edward C. Mann has reported the treatment of blindness and deafness resulting from cerebro-spinal meningitis,\* a disease generally considered as incurable. He believes that in the constant current we have a means more powerful than any other of modifying the nutritive conditions of parts that are deeply situated. We believe that the results of our investigation in this direction will lead us to be able to class blindness and deafness resulting from cerebro-spinal meningitis among the curable forms of diseases of the nervous system.

From Vienna we hear, by Dr. H. L. Morse, that electricity is used there for the relief of tinnitus. A weak current of galvanism is used, and sometimes followed by the faradic induced current. The results vary. Urbantschitsch uses electricity for otalgia.

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\* *New York Medical Abstract*, January, 1881.

### *Hysterical Deafness.*

This form has been cured by electricity. Cases have been published by M. Ouspensky, of Moscow,\* in the "Annales des Maladies de l'Oreille."

The electrical examination and diagnosis of the ear has been treated by our fellow, Dr. W. F. Robinson, in Section B, page 56, in "The International System of Electro-Therapeutics."

Cataphoresis in labyrinthine deafness has been used by Dr. Gagney, of London,† and reported November 7th, 1889, at the Harveian Society. He used Lugol's solution, etc.

Nervous deafness has been successfully treated by Erb, Brenner and De Watteville by excitations of the auditory nerve by galvanism, with interruptions.‡

Automatic instruments of electricity have also come into existence. Dr. Henry C. Houghton, of New York, has constructed one, and read a paper, "A Phono-Faradic Massage Battery for the Treatment of Aural Cases."§

Mechanical massage by electricity is indicated in thickening of the drum, partial paralysis of the nerve, or ankylosis of the ossicles, etc. A weak faradic current will help to break up the adhesions between the ossicles in sub-acute catarrhal otitis media, a disease very difficult of treatment.

### *Deafness from Strictures of the Eustachian Tube.*

As strictures of the eustachian tube are formed in a similar way to strictures of the urethra, it is very plausible that they should be cured by electrolysis like other strictures formed after chronic inflammations. Others have argued in a similar measure, and made cures accordingly.

In a paper read in Brooklyn at the first meeting of the Fifth District Branch of the New York State Medical Association, October 13th, 1885,|| the writer mentioned cases of M. Mercier and

\* *Cincinnati Lancet and Clinic*, April 8th, 1898.

† *British Medical Journal*, November 16th, 1889.

‡ Leszyusky, Section K, "International System of Electro-Therapeutics."

§ *Journal of Electro-Therapeutics*, April, 1898.

|| *Gaillard's Medical Journal*, December, 1885.

M. Garricon-Desarines.\* Their operation consisted in passing a fine silver sound into the eustachian tube, and a small olive-shaped electrode into the external auditory meatus. A feeble current is then passed, the sound is gradually pushed on, and the stricture disappears.

In 1890, while in London, Dr. W. E. Steavenson communicated to the writer his treatment of eustachian obstructions, in St. Bartholomew's Hospital, which he conducted, together with the aural surgeon, Mr. Cumberbatch. The first seven cases were reported† in Steavenson's "Electrolysis in Surgery," and the writer has mentioned these cases in his Section M, page 46, "International System of Electro-Therapeutics." The operation had then been performed a large number of times without any unpleasant experience; nor had the treatment anything more than very temporary discomfort to the patients. In those cases in which the deafness has been due to a simple obstruction of the eustachian tube the results have been most encouraging.

Other electro-therapeutists have followed, and it is pleasant to state that some specialists use now with success electrolysis in stricture of the eustachian tubes. Among the latter is particularly Dr. Arthur B. Duel, of New York, whose report has been mentioned in several journals, and it may be of general interest to quote from his article in the *Journal of Electro-Therapeutics* of March, 1898 :

"Dr. Arthur B. Duel says that one of the chief causes of deafness and tinnitus aurium is the narrowing of the lumen of the eustachian tube by hypertrophy of the sub-mucous tissues surrounding it, thereby preventing the maintenance of the normal air pressure behind the tympanic membrane.

"He recommends the following method : For the purpose of conducting the current he has had four copper bougies, varying from No. 3 to No. 6 (French scale), mounted on No. 5 piano wire. These are passed through small, insulated, pure silver catheters and drawn back until the bulging portion of the bougie fits tightly in the mouth of the catheter. The other end of the wire is fastened an inch and a half from the funnel-shaped end of the catheter to

\* *The Lancet*, November 24th, 1888.

† *Academy de Medicine*, Paris, March 11th, 1884.

the handle which connects it with the negative pole of the battery. The positive pole is connected with the patient's hand by means of an ordinary contact electrode. The battery should be supplied with a perfect rheostat and milliamphere meter.

"The bougie is passed through the tube in the usual manner, the tip being pushed forward until it is felt to be obstructed by the stricture. The current is then slowly turned on until from two to five milliamperes are used. It is never necessary to use more than this, and probably the best results are obtained by a longer contact with a small amperage than *vice versa*. After a contact of from two to five minutes the bougie is felt to pass on through the softened stricture with a slight pressure. The bougie is then slowly withdrawn and the current gradually turned off before removing the catheter. The current should never be opened or closed suddenly."

The whole procedure of Dr. Duel's is very sensible, arranged according to the rules of aural surgery, and the laws of electro-therapeutics, and meets fully the writer's rules for the application of electrolysis in the treatment of strictures.

Reports say that Dr. Edward B. Deuch, aural surgeon, New York Eye and Ear Infirmary, also uses electrolysis with success in strictures of the Eustachian tube. Statistics could not be procured directly as the doctor is in Europe, when this paper was written.

Sometimes patients have been sent to the writer for the treatment of eustachian obstructions by electrolysis, who have had professional care by the best specialists in the country without success. Knowing how difficult such cases are to handle, and not being a specialist for ear diseases, in some cases Dr. Edward S. Peck, of New York, partook in these operations, and helped to devise a new instrument. We have had considerable success and the details of a few cases will be given here for illustration.

#### *Case I.*

December 30th, 1894.—Mr. J. E., aged 35, was sent to me from Chicago by Dr. Nieswanger. He was almost deaf, had been suffering from catarrh for a long time. Five years ago he began to feel that hearing was a little impaired, first on the right side. An excellent specialist of St. Louis examined and made the

prognosis that the hearing would grow gradually worse. He had a musical education, and could distinguish discords in singing or on musical instruments.

Hearing became gradually worse, and unpleasant noises in ears troubled him. One year ago an authority in New York found, on examination, that the anatomical relations of the ears were normal; but hearing nevertheless was much impaired. No treatment would cure or improve him. He has been treated in Hot Springs and other localities in various ways. Operation on the turbinated bones improved breathing; galvano-cautery and inflation by Pollitzer's method, however, did not help at all. He has still catarrhal discharges, and his hearing is much impaired. Left nasal canal is smaller than the right; partial deafness is more on the right side.

December 31.—Dr. E. S. Peck made a careful examination in consultation with me, found anatomical relations of ears normal, passages however full of catarrhal secretions and strictures in both eustachian tubes.

January 2, 1895.—Electrolysis in right eustachian tube. The catheter was introduced till arrested by the stricture and then connected with the negative pole of a galvanic battery. An electrode pad in the hand was used as the positive pole. The current from  $2\frac{1}{2}$  to  $3\frac{1}{2}$  milliamperes was used for five minutes, during which time the movable point of catheter advanced 4-10 of an inch in the stricture. No unpleasant symptom was experienced.

January 4.—Patient considered his hearing improved. Electrolysis was used in right ear in the same manner as before.

January 6.—Electrolysis repeated. Right ear 5 milliamperes for six minutes, the movable electrode advanced 3-10 of an inch. Left ear 4 milliamperes for three and a half minutes, electrode advanced 4-10 of an inch.

Patient felt improved and had no unpleasant symptoms. After two more seances patient felt so much improved that on account of urgent business in Chicago he left for home. Time allowed was too short to expect an entire cure, but he felt content with the improvement, and all that could be learned afterwards was favorable.

For future use we constructed an improved electrode, which

may be described as follows. The instrument consists of a hard rubber eustachian catheter, shortened one inch. Of course the hard rubber is an insulator. Through the hollow tube is inserted a metal electrode, the end emerging from the open catheter as a small egg-shaped bulb or olive, like the bulb in the writer's electrodes for the urethra. From the exterior end of the catheter emerges a conical cylinder, which is divided in ten equal rings, each representing 1-10 of an inch. On the outer side is a binding screw for the attachment of the rheophore to the negative pole of the battery. The rod can be pushed forward by 1-10 of an inch at a time to 1 full inch, so that when the rod is pushed inside the catheter, the length of the whole instrument is just as long as any eustachian catheter; the 1 inch conical piece restituting the 1 inch taken off the catheter.

The *modus operandi* is similar to the treatment of an urethral stricture. The catheter is introduced into the eustachian tube with great care till the stricture arrests its progress. When it is attached to the negative pole of the galvanic battery, the patient takes in his hand as a positive pole a moistened pad or handle. The current is from zero very slowly increased, according to the toleration of the patient; but, as a rule, should not be stronger than 5 milliamperes. The operator guides very gently the inner tube as the electrode, and pushes it forward only when the electrolytic current has absorbed the obstructions, and must never do too much in one seance. Undue force must never be used, the electrolysis must do the work of absorption. The milliampere meter is a necessity. The current must be steady, slowly increasing, and before removing the catheter slowly decrease to zero. Otherwise all rules should be observed which the writer has given for the treatment of urethral strictures by electrolysis.

Another case will demonstrate the details and progress of the treatment.

*Case II: Twelve Years' Aural Catarrh; Two Years' Deafness.*

November 9, 1897.—Mrs. J. M., age 40 years, married, has had catarrh for twelve years, for which she has been treated off and on. Hearing has been affected, but the real deafness is two years old. Has been treated south in St. Louis, and New York, by very competent authorities, in the regular routine manner. She com-

plained of much trouble from dyspepsia, meteorism, poor appetite and getting tired easily. Bowels were somewhat constipated. Tongue was clear.

Consultation with Dr. E. S. Peck, who examined and treated the patient together with me.

A. D.—Watch heard feebly in all regions.

A. S.—Watch heard much better in all regions.

Slightly loud spoken voice at six feet, and for right ear the same at three feet.

November 19.—Electrolysis, eustachian catheter inserted as the negative pole.

Positive electrode pad in hand. Five milliamperes for five minutes, during which time the electrolysis advanced the catheter 4-10 of an inch.

November 21.—Electrolysis by eustachian catheter as negative pole; positive in hand. Five milliamperes for 5 minutes, advanced 6-10 of an inch. Electrolysis to left side eustachian tube. Positive pad behind the mastoid. Three milliamperes for 4 minutes, catheter advanced 4-10 of an inch.

A. D.—Voice slightly raised at  $2\frac{1}{2}$  feet. Cutaneous surface is very sensitive to the electric current.

November 23.—A. D.—Eustachian catheter, 6-10 of an inch for 5 minutes, 5 milliamperes.

A. S.—Eustachian catheter, 2-10 of an inch for 5 minutes, 6 milliamperes.

November 25.—General galvanization. Positive in hand. Negative behind ear and over mastoid. Five milliamperes. Skin very sensitive. Five milliamperes reddened skin, caused a metallic taste, and only a fraction of one millampere caused dizziness.

November 26.—Electrolysis with eustachian catheter as before.

A. D.—7-10 of an inch advanced, 6 minutes, 6 milliamperes.

A. S.—2-10 of an inch advanced, 4 minutes, 6 milliamperes.

November 28.—A. D.—Electrolysis, eustachian catheter advanced 8-10 of an inch, 5 minutes, 5 milliamperes.

A. S.—Electrolysis, eustachian catheter advanced 3-10 of an inch, 4 minutes, 5 milliamperes.

November 30.—A. D.—Electrolysis, eustachian catheter advanced 9-10 of an inch, 5 minutes, 5 milliamperes.

A. S.—Electrolysis, eustachian catheter advanced 3-10 of an inch, 4 minutes, 5 milliamperes.

December 3.—A. D.—Electrolysis, eustachian catheter advanced 10-10 of an inch in 5 minutes.

A. S.—Electrolysis, eustachian catheter advanced 6-10 of an inch in 5 minutes.

December 5.—A. D.—Electrolysis, catheter advanced 10-10 of an inch, 5 minutes, 6 milliamperes.

A. S.—Electrolysis, catheter advanced 7-10 of an inch, 5 minutes, 5 milliamperes.

December 7.—A. S.—Electrolysis, advanced 8-10 of an inch, 5 minutes, 5 milliamperes.

December 15.—A. D.—Electrolysis, advanced 10-10 of an inch, 5 minutes, 5 milliamperes.

A. S.—Electrolysis, advanced 7-10 of an inch, 5 minutes, 5 milliamperes.

December 19.—A. D.—Electrolysis, advanced 10-10 of an inch, 6 minutes, 6 milliamperes.

A. S.—Electrolysis, advanced 8-10 of an inch, 6 minutes, 5 milliamperes.

December 24.—Electrolysis, eustachian tube advanced on both sides to its full length, 10-10 of an inch, in 6 minutes with 6 milliamperes.

December 29.—Electrolysis as before on both sides, full length, 10-10 of an inch of catheter.

1898.—During January the same treatment was continued and eight seances held—when patient went home very much improved.

The strictures of the eustachian tubes have been cured by electrolysis; but patient suffers from other ailments in the auditory anatomy, which specialists have not removed.

1. The object of this paper was to show that electrolysis can cure stricture of the eustachian tube.

2. To induce the profession, and particularly the aurist, to add electro-therapeutic measures to the treatment of the ear in deafness, and particularly when other means will not cure.

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NOTE.—January, 1899: Patient has been seen; found eustachian tubes clear, no obstructions.

## DISCUSSION.

Dr. LUCIEN HOWE, of Buffalo, N.Y., thought we should be very careful in receiving the data as data, and drawing conclusions from them. In the first place, nothing is more difficult than to exactly diagnosticate stricture of the eustachian tube, except in those ephemeral forms which change constantly. The cases of chronic closure are extremely difficult to diagnose, and after the diagnosis has been made, it is known that the pathological changes are not *in* the tube, but elsewhere. Pollitzer has recently shown that in those cases which have been treated for years as closure of the eustachian tube there has been an ankylosis of the stapes. Hence there are other changes than stricture of the tube which are present in the later stages. In the third place, he thought the instrument employed was a dangerous one. Aurists had been over that ground pretty thoroughly. The interval between the eustachian tube and the carotid artery is only equal to two or three thickness of paper. He could not understand even how the instrument exhibited could be passed sufficiently deep to reach the stricture. These practical objections were so important to his mind that he ventured to present them.

Dr. A. D. ROCKWELL, of New York, said that he desired to confirm what Dr. Howe had said regarding the difficulties of diagnosis in these cases. As far as concerns the effect of electrolysis on cicatricial contraction, wherever found, he must say that his own opinion, backed up by practical experience, was not in favor of such electrolytic treatment. Of course, a negative is not considered as valuable as positive evidence, nevertheless he could give very positive illustrations concerning the positive failure of electrolytic treatment of stricture, drawn not only from his own experience but from that of other and well-known clinical observers. If in the future it was thoroughly established, as it has not yet been in conservative surgery, that three or four, or even eight or ten milliamperes—which was probably the limit—would favorably affect cicatricial contraction he was willing to stand as having been greatly in error. If the reverse were proven, then those who honestly claim now that electrolysis is efficacious must acknowledge their error.



Dr. MARGARET A. CLEAVES, of New York, said that the reason for the differences of opinion among us as to the value of the continuous current in overcoming strictures was dependent upon the degree of inflammatory deposit. She was confident that recent products of inflammatory action can be removed by the continuous current; but when the inflammatory products had become firmer, and partook more and more of the nature of cicatricial tissue, she did not believe the current would exert any beneficial action. It was on this point that our opinions divided.

Dr. ROCKWELL remarked that he had referred only to the cicatricial cases.

Dr. NEWMAN said that he had demonstrated the decomposition of the salt in electrolysis over and over again, and had shown the cure of strictures in thousands of cases, and Dr. Massey had stated that electrolysis had no limitations. Some of the members knew that his cases were cured. He had compiled 1,755 cases of this kind that had been cured, and a committee from this association had examined his records and had confirmed their validity. One observer had noted even the electrolysis of bone. Dr. Rockwell had reference to the genito-urinary surgeons, but these surgeons do not know anything about electricity, and if they adopted the electrolytic treatment they would have to take eight or ten dollars instead of, as now, three hundred dollars for cutting a stricture.

Regarding what Dr. Howe had said about the danger of the procedure, he would only reply that the catheter should not be inserted by those who are not sufficiently skillful. If the instrument exhibited by him were dangerous, then the ordinary eustachian catheter is dangerous. As regards the diagnosis, he would say that the diagnoses had not been made by himself, but by accomplished specialists in ear diseases. No sane man would push the instrument through the stricture; any careful clinician would gently and cautiously feel his way with the instrument through the stricture. Electricity does not act by dilatation, but by absorption. Dilatation means the exercise of more or less force, as in the use of conical urethral sounds by the genito-urinary surgeons.

Dr. G. BETTON Massey, of Philadelphia, Pa., having obtained special permission of the association to speak after the discussion had been closed, said that Dr. Newman had quoted

RECORDED

him as saying that there were "no limits to electrolysis." He had not made that statement. He said, however, that a man's body could be dissolved by electrolysis; and he had also said, he believed that there was a limitation of expediency, and this latter remark applies particularly to the class of troubles under discussion. It was necessary in such cases to use a very mild current. It did not seem to him wise to take the position that since we were limited in such cases to from three to five milliamperes it was impossible to accomplish good results, because we had the advantage of returning again and again with that small current. He was sure that in many forms of stricture where we are limited in our use of this unlimitable agency—because, as Dolbear had shown, electricity can accomplish all chemical action—the repeated application of this agent will secure absorption. As to the opinion of the genito-urinary surgeons of New York, or the opinion of the American Gynecological Society, we might as well get the opinion of the Association of Buffalo Butchers as to the value of these agents. These things are entirely outside of the experience of these gentlemen, and they are moreover decidedly opposed to this method of treatment.

## The Use of Electricity in Acne Vulgaris and Acne Rosacea.

By GROVER WILLIAM WENDE, M.D., Buffalo, N.Y.

Nowhere within the wide domain of medical science can be found a class of diseases so manifold in manifestations, so embarrassing to the patient and so trying to the physician as the class known as "The Acnes." These consist of two distinct affections, namely, Acne Vulgaris and Acne Rosacea. Each of them possesses peculiar and striking features, the one being marked by its well-defined varieties, and the other by its characteristic stages and complications.

Acne vulgaris consists of an inflammatory and functional disorder of the skin, having its seat in and around the sebaceous glands; while acne rosacea is an abnormal chronic hyperæmia of the face, characterized by redness, dilation, enlargement of the blood vessels and connective tissue hypertrophy. It usually consists of two processes—an acne and a rosacea; the acne being secondary.

The discussion of these maladies, generally so insignificant and harmless, might, at first glance, appear quite commonplace, were it not for their frequent occurrence and chronic course. However, an honest practitioner, after groundless suspicion of a blood dyscrasia, will, upon careful investigation, establish many interesting points of practical value regarding their true nature and therapy—points not so readily discernible in other skin affections, which will well reward his efforts to bring about a cure.

The fundamental idea of the treatment of acne is to remove disfigurements by the employment of such local applications to the affected parts as are calculated to produce stimulation and discourage hyperæmia. The attempt is then made to remove the cause of the disease by internal administrations. Here we are often at a loss, by reason of the various concealed contingents of the affection. Hence the proper treatment of acne often depends upon two factors—the local and the constitutional. The

effort should always be made to exterminate the one from which the more danger is likely to result. We must endeavor to determine the source of the characteristic irritation before we can treat the disease intelligently and with any hope of success ; in fact, the only hope of successful treatment lies in an accurate knowledge of its etiology. Accordingly, in many cases where the cause is definitely known, the result is favorable ; while, on the other hand, if the etiological factor is obscure, all remedies, no matter how much extolled, will utterly fail. The treatment of these conditions must depend on the special features of each case.

According to Dr. Bulkley, the causes of acne are :

1. General—pertaining to classes of cases.
2. Special—constitutional and systemic.
3. Local.

There are, however, numerous cases whose causes are ill-defined and which do not respond to ordinary treatment, but present features which demand special remedies. According to my experience, these should be assigned to the last division of the classification made by Sir John Hunter, and based exteriorily upon therapeutical results :

1. Those that sulphur will cure.
2. Those that mercury will cure.
3. Those that the devil himself cannot cure.

Owing to the rapid strides made by electricity, cases of acne that were formerly found under this last heading only, have gradually grown less so that, now, those which do not yield to ordinary treatment can be successfully overcome by the use of the electric current. When this is applied to the cutaneous surface the process is characterized as electro-dermato-therapy. A large proportion of skin diseases is due either to an exalted or depressed condition of the nerves which govern circulation, excretion, secretion and nutrition, and the employment of electricity in these instances has been fully sanctioned by modern investigations.

It is not impossible that during the development of the body—from fifteen to twenty-five years—the excretory powers of the sebaceous glands are largely under the influence of the nervous system. By reason of this, their functional activity is much increased and a greater amount of sebaceous matter is produced,

whereby the common ducts and orifices are likely to become obstructed. It is indisputable that the more the subject is studied, the more certain it is to appear that an exalted or depressed condition of the nerves controls the secretions of the sebaceous glands. This is most apt to occur at puberty. Indirectly, the functional disturbance is frequently brought about by the influence of certain particular organs, in which case special consideration and treatment will be demanded.

In many cases the local cause of acne exists independently, and will be found to be due to the sluggishness of the integument. The cutaneous muscles are deficient in tone, and do not respond to the contractile power of the nerves controlling them, while the epidermis is thick, opaque and devoid of expression. This is the most favorable condition for the development of a general acne. These special conditions may be remedied by either general or special treatment.

Before adverting to the benefits to be derived from the application of electricity in certain forms of acne, it is important to note that the current may be employed to advantage in two different ways :

1. By electric stimulation and irritation, to be applied by means of the ordinary sponge-electrodes.
2. By electrolysis, for the destruction of chronic and indurated lesions, using the ordinary electric needle.

In the employment of the sponges, it is not necessary or expedient to open the pustules or remove the comedones. Solution of continuity should be avoided. The galvanic current should be applied in exact accordance with the bipolar method, as follows : The electrodes, after having their surface properly covered with moist absorbent cotton, are placed upon the face, in close proximity to each other, and their position is constantly changed until the skin becomes well reddened. The current must be continuous, and is to be regulated by the ability of the patient to endure pain. Should the skin be extremely sensitive, the anode can be held *in situ* and the cathode employed in gently stroking the face. To be thoroughly effective, five or ten cells are generally required ; an application fifteen minutes in duration is usually sufficient to accomplish the desired result.

To cause a more sudden resolution in chronic manifestations, such as indurated papules, electrolysis is made use of, by puncturing the lesion at the centre with an irido-platinum needle, as many times as the immediate condition may seem to require. The puncture must be made by the galvano-negative ; a current of from one to four milliamperes will usually be sufficient.

My own experience with electricity in its therapeutical relations to acne vulgaris has been limited to twenty-two cases which have failed to respond to the usual remedies and methods. After three months' trial, the application having been made on alternate days, three of the cases seemed to have received no benefit, eight were partially cured, while the remaining ones manifested but a temporary improvement. As in other forms of treatment, relapses occurred—a frequent sequence of acne—however, these cases would afterward respond to the current, showing the best results in the treatment of this particular condition by electricity.

The report of a case that had resisted every known treatment, but, at my hands, yielded to the irresistible forces of electricity, is here given, to illustrate how intrinsically interesting and wonderful are the effects of this more modern agent in connection with acne, even in the most obstinate and defiant cases :

Josephine J., aged 35 ; first seen by me in June, 1895 ; family history unimportant ; had suffered from acne since the age of 16. She presented no physical signs of disease ; there were no digestive disturbances and no irregularities in menstruation. When she came to me her cheeks, chin and forehead were literally covered with papules and pustules in different stages of formation ; there were also numerous well-defined scars of a moderate character, one-eighth of an inch in diameter, and especially noticeable upon the temples, neck, and the upper and outer portions of the cheeks. The appearance of the patient would seem to indicate that she was suffering from a large papular syphilide ; indeed, she had been treated for this affection, on several occasions, by other physicians. For two years she received from me the recognized treatment for the malady. Her diet was restricted and moderate, and increasing exercise was advised. The remedies which were administered internally mainly consisted of different alkalies, ergotine, iron and general tonics, as the exigencies of the case

required. Externally, various applications, composed of well known drugs, such as sulphur, bichloride of mercury, ichthyol, boracic acid, etc., in different proportions and combinations, were employed. Notwithstanding these efforts, and the benefit usually derived from the remedies in like cases, the lesions continued to develop. Eventually, it was determined to discard everything in the line of material agencies and to begin the use of electricity. The active and most prominent lesions, such as large papules and pustules, were first destroyed by inserting into the centre of each a sharp-pointed irido-platinum needle, connected with the negative pole, while the positive sponge-electrode, well moistened, was placed in the patient's hand. A weak current, not exceeding five milliamperes, was employed, and its effects were carefully watched. When the skin became blanched and a clear white ring of froth formed around the needle, it was withdrawn. In the majority of instances, two or three sittings were necessary to insure complete removal. Having thus cleared the face of the larger papules and pustules, the next thing was to remove the smaller lesions and erythematous blotches; this was accomplished by allowing the galvanic current to pass through moistened sponge-electrodes, placed in close proximity upon the face, and gently moved about until a sensation of warmth was felt by the patient and the skin was generally reddened. Usually it would be from fifteen to twenty-five minutes before the electrodes were removed. The applications were made on alternate days and extended over three months, when the patient was discharged as cured. The use of the needle left no scars. More than eight months have elapsed since the treatment was discontinued, and there has been no return of the affection.

In considering acne rosacea, a few of the special influences at work in connection with the disease should be mentioned, that a rational idea may be formed concerning its proper treatment. The affection, at first, manifests itself as an angio-neurosis, undoubtedly due to excessive irritability of the muscle-tone of the cutaneous vessels, characterized in the initial stage by a prolonged or rapidly repeated stasis in the capillaries. All the superficial pathological changes are based upon this simple fact. It is interesting to observe in these cases the intimate connection of the sympathetic

and the circulatory system ; this being especially marked in cases where there is rapid development and repeated change. When the indications seem to demand quickened circulation, for the purpose of aiding absorption and changing nutrition—these being usually apparent in the earlier stages of acne rosacea—we have every reason to believe, from analogy, that external galvanism will sooner restore the skin to its normal condition than the stimulating effect of sulphur or that of any other drug, topically applied. In addition to its effect in altering the local condition, it relieves the reflexes to which the disease is frequently due. We have thus a rational explanation of the origin and nature of the disease, for no part of the body can be healthy unless there is an harmonious inter-dependence between the histolytic and the histogenetic functions.

As an illustration of the beneficent results derived from the more direct electrical treatment by galvanism, the following cases may be cited :

Mrs. K., aged 36 ; delicate and nervous constitution ; married, has had two children ; habitually constipated ; poor circulation ; hands and feet apt to be cold ; subject to headaches ; very nervous immediately prior to menstruation ; first affected six years ago. The face, on the cheeks, nose and forehead, on the mesial line, had become intensely red ; the capillary vessels were dilated and a number of disseminated inflammatory papules were visible. The measures employed for this particular form of the affection were both local applications and constitutional drugs. No factor or feature of the case was overlooked ; the dietary was modified, constipation was relieved and the uterine disorders were duly considered. There was, however, no improvement in the hyperæmic nature of the difficulty and the nervous condition of the patient seemed to be augmented. But, however, after a time corresponding to that covering the regulation treatment, some eight or nine months ago, galvanism was employed by placing the anode on the abdomen, over the solar plexus and gently stroking the affected parts of the face with the cathode. At the expiration of eight weeks the condition of the patient was materially ameliorated, clearly demonstrating the value of the electric method over all others.

In cases where hypertrophic changes ensue, with an actual increase of connective tissue, and the blood vessels are tortuous and largely dilated, electrolysis must be resorted to, in addition to galvanism topically applied. It has been my own custom, in applying the electric current to follow the plan adopted by Hardaway, which he claims is less painful and more effectual than to pass the same amount of current through the ordinary sponge-electrodes. His plan consists in attaching the needle used for the destruction of the hypertrophy and dilated blood vessels to the anode, and in connecting the cathode with a bowl of water into which the patient introduces one finger or more, as may be necessary to complete the circuit and accomplish the desired result. In cases having a moderate amount of the diffused redness, transversed by tortuous capillaries, a disk-electrode should be used, in which may be placed ten or fifteen cambric needles for introduction into the affected skin. A weak current, measuring two or three milliamperes, of one or two minutes' duration, is usually sufficient. The new insertion should include the edges of the places previously treated. The vigor of the application naturally varies, and should be governed by its reaction, which is manifested by redness and tumefaction in the parts treated. If carefully watched no inconvenience to the patient will result, and the action of the current will be thoroughly satisfactory. Not more than three or four areas should be treated at one sitting, nor should the same locality receive treatment oftener than once in a fortnight.

For the destruction of the enlarged veins, a broad-pointed needle is recommended, which should be thrust into the vessel and a current of about three milliamperes allowed to pass into the affected part. If the vein is long and tortuous the operation must be repeated, according to circumstances. A given portion of the surface can be successfully treated at one and the same time. If ordinary care is taken in the course of the operation, and it is skilfully performed, there will be no evidence of cicatrization, even under a magnifying glass.

In conclusion, we must all admire the use of electricity in the treatment of the disease here named. It is not only most beneficial to the public, but it is an exceedingly valuable remedy in the hands of the profession—more valuable than any other which

is calculated to relieve rosacea, employed either in medicine or surgery. It is especially efficient in connection with the peculiar appearance to which the terms "red-light" and "grog-blossom" have so pertinently been applied by almost everybody, both laymen and professionals, and of which a classical instance is furnished in Shakspeare's wonderful description of the face of the doughty Bardolph: "His face is all bubukles and whelks and knobs and flames o' fire; and his lips blow at his nose, and it is like a coal o' fire, sometimes blue and sometimes red."

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#### DISCUSSION.

Dr. G. BETTON MASSEY, of Philadelphia, Pa., said that the paper was an instructive one, yet he would like to refer to certain points in the technique. In the treatment of extensive areas of acne vulgaris, on the face and elsewhere, he would advise the use of larger pads, and that they be separated more widely. It was also well to employ a face mask. A pad may be easily constructed of layers of absorbent cotton, well saturated with water, and over them a soft metallic plate. If the cotton were thoroughly saturated, perfect coaptation would be secured. The current strength is of considerable importance, and he believed if large areas were simultaneously treated a current of considerable strength would probably prove efficient. There should be a difference in the results obtained with the two poles; but his own experience would not allow of his speaking definitely at present on this question of polarity. He suggested that cataphoresis would be found a valuable adjuvant to the treatment.

Dr. MARGARET A. CLEAVES, of New York, said that she had been extremely interested in this valuable paper. In using the continuous current in the treatment of acne, the indifferent electrode (which should always be the positive) should be placed at some point which interposes the least resistance to the current. The nape of the neck is probably the best in the treatment of acne. A labile application should be made with the negative pole. Many cases of acne vulgaris yield to an application of slow interruptions of the induced current, about twenty or thirty

interruptions per second. We had only to think of the role of muscular action to account for the value of such an application. She had succeeded in curing some very obstinate cases of acne by the use of the induced current and by attention to the general health. In other cases, of course, the continuous current had been necessary. In an exceedingly obstinate case she had succeeded by the use of metallic cataphoresis with copper.

Dr. ROBERT NEWMAN, of New York, said that the author of the paper had made the statement that although he used electrolysis on the face, no scar had been left. He could not have done him a greater favor than by making that statement. This showed that there had been absorption without cicatrization, and confirmed his contention that cicatrices could be harmlessly absorbed by the proper use of electrolysis.

Dr. EMIL HEUEL, of New York, said he could confirm what had been said about the freedom from scars in the electrolytic treatment of nævus. In one very obstinate case he had effected a complete cure after twenty-five sittings, of five minutes each, using a current of from three to five milliamperes.

Dr. ALFRED T. LIVINGSTON, of Jamestown, N.Y., said he thought Dr. Newman should draw a distinction between the absorption of the eschar and the destruction and replacement of it by a tissue which is not at all cicatricial. His own experience was that electrolysis need not be followed by cicatrices when employed on the surface, as in the removal of hairs and nævi. The increased activity of the circulation and the improvement in the nutrition of the parts probably accounted for this freedom from the formation of scars. A sharp distinction should be made between the destruction of cicatricial tissue and its replacement by normal tissue.

Dr. MASSEY referred to the more extensive application of an electrode and the use of absorbent cotton. He had employed, and very much preferred, a pasty mass of clay, which had been made as moist as possible without running. This clay is placed on the surface, and on it is placed the metallic electrode. This gives better contact than the cotton, and allows of the use of a much larger current without discomfort.

Dr. WENDE said, that, being a dermatologist, he might be excused

for not knowing all the points mentioned in connection with the technique. The prime requisite was to secure stimulation, and it did not seem to him that this was as well attained by the method described by Dr. Massey. He believed there was a loss of tone and contractile power in the sebaceous ducts. As to the destruction of the lesions without scarring, he said that as long as the operator kept out of the subcutaneous tissue there would not be a scar; on the other hand, if the subcutaneous tissue were destroyed a scar could not be prevented.

class of diseases that may be termed nutritional. Some of these are even more hopeless than either organic or structural diseases, and yet neither the microscope nor other methods of precision have revealed those molecular changes in nutrition that must be the underlying causative factors in such nutritional diseases as the general paralysis of the insane and palsy agitans. With what are commonly termed organic diseases, and especially the coarse organic changes in the brain and spinal cord, we have little to do, and in these conditions electricity is for the most part relegated to diagnostic uses.

Whatever good is derived from the use of electricity is confined mainly to certain structural changes of the spinal cord.

In considering the diagnostic value of electricity in diseases both organic and structural of the central nervous system, we are to remember that muscular paralysis is due to changes somewhere along the path between the cortical motor cells of the brain and the muscular fibres, and that quite different effects follow according to the location of the pathologic change along this path. The pyramidal cell of the cortex has short branching processes called dendrons. These dendrons are made up of fibrillæ, which, after leaving the cell pass down the cord under the name of axis cylinder process, or axon. These unite with the short processes of the spinal cord motor cell, and constitute the lower segment of the course along which flow motor impulses.

Beyond, lie the posterior roots, connected with this lower segment by its fibrillæ, and with the muscular fibre by the great axis cylinder process. While loss of muscular power (paralysis) indicates disease either of the upper segment (cortical motor cell) or of the lower segment (spinal cord motor cell) eliminating always causes of a purely peripheral character; impaired muscular nutrition, as indicated by atrophy and lost faradaic irritability is the result of damage to the lower segment; i.e., to the motor cells of the grey matter of the spinal cord. While disease of either segment then may result in motor paralysis, that of the upper segment or cortical motor cells of the brain interferes not greatly with nutrition or reflex action except to increase it; while disease of the lower segment, or the motor cells of the grey matter of the spinal cord, results in loss of reflex action, impaired nutrition and mus-

cular wasting. As a rule the faradaic current is sufficient for diagnostic purposes, while the galvanic current is especially valuable as an aid to prognosis. If the paralyzed muscle contracts normally to the faradaic current, we know that the muscular fibre is well nourished, and that the central pathologic change (eliminating, of course, a peripheral causation) involves either the brain or the white substance of the cord. If farado-muscular contractility is lost or distinctly diminished, it is probable, although by no means certain, that there is degeneration of the muscular fibre, and that this degeneration is due to disturbance of nutrition somewhere in the tract between the multipolar cells in the anterior cornua and the peripheral nerve distribution.

#### *Paralysis from Brain Disease.*

Hemiplegia is the symptom of special interest in considering the relation of electricity to brain lesions, although it is difficult to see how it can be of very much service in any other way than by its generally invigorating effects, or its power to hasten absorption. By the rapid change of potential in the use of static electricity we attain this end of invigoration more perfectly, perhaps, than by any other method. Through molecular agitation we excite and quicken both metabolism and nutrition. The distinguishing features between paralysis from brain and spinal cord disease are, as a rule, so clearly defined that it is unnecessary to call upon electricity as an aid to diagnosis. Still, it is an interesting fact to note and to be borne in mind that after an attack of hemiplegia, whether due to direct damage to the cortical grey matter of the brain from haemorrhage, to embolism, or tumor, the nutritional disturbance of the paralyzed limbs is very slight, and any disturbance of muscular irritability is in the direction of an increase and not a decrease. Whatever decrease of muscular irritability subsequently occurs is due to atrophy from disuse, and not from any direct disturbance of nutrition. The faradaic current, therefore, may be used to advantage sometimes to retard this wasting through disuse, but neither current possesses any value in restoring directly motility to the paralyzed members. This improves only as the brain clot is absorbed and contracts. The interesting question arises, "Is electricity of any value in hastening this process of

absorption?" Much doubt has been thrown upon the generally accepted idea that the galvanic current directly affects the brain; but the experiments in proof of this negation are far from conclusive.

At all events, clinical experience so positively demonstrates the therapeutic value of galvanization of the head in certain symptoms of central origin that it is difficult to believe that these good results depend upon reflex effects alone, as suggested by those who doubt its direct effect. If, however, the galvanic current does directly affect the brain, the impression made must necessarily be so inconsiderable through the rapid divergence of its lines of force as to have only the slightest possible local influence.

Theoretically, its absorptive power over a distant blood clot should be almost *nil*; and, practically, it is doubtful if much good comes from it. This at least has been my experience. In any recent case of hemiplegia, therefore, and especially when there is an increase of muscular irritability, electricity is of doubtful value, and in ignorant or careless hands may do harm. In old cases, however, where from disuse there is atrophy associated with decreased muscular irritability, there can be no objection to its use, and its tendency certainly is to improve nutrition.

One need not hesitate in these cases also to apply the galvanic current directly to the head in a longitudinal direction, in order to avoid the apparent circulatory disturbance and the dizziness which result from transverse galvanization. If it does no good, it need do no harm, and in a pathological condition, where our therapeutic resources are so limited, it is rational to employ any method that offers any hope whatever. Disease of the nerves of special sense, especially of the olfactory nerve, resulting in anosmia, has been known to accompany hemiplegia; and I myself have seen two cases of this kind, in one of which electricity was distinctly beneficial. In this case the nerve elements were, without doubt, structurally perfect and only functionally inactive, and were capable of responding to the galvanic stimulus.

I cannot dismiss this subject without referring to a form of hemiplegia from which patients occasionally recover with such promptness, and in which electricity has been known to prove of such value as to completely negative the idea of an organic or

structural causation. We know very little about spasm of the vessels as a cause of hemiplegia ; but there appears to be no other cause to which to attribute these sudden and transient attacks, several of which it has been my fortune to see. One of these cases, in which a *post mortem* was finally held, fell under my observation a long time ago.\* The attacks were intermittent in character, resulting in partial hemiplegia, which would soon pass away. A *post mortem* examination revealed various abnormal conditions of the brain, but neither haemorrhage nor occlusion of any vessel, rendering it probable that the cause was spasmodic. An interesting point connected with the case was the fact that the galvanic current, applied for the purpose of affecting the vaso-motor system, resulted in an immediate cessation of these attacks. For three months they did not again occur, when one, unusually violent, proved fatal.

#### *Paralysis from Spinal Disease.*

We have seen that in organic brain disease the very limited indications for the use of electricity are found mainly in the later stages of hemiplegia from cerebral haemorrhage. In spinal disease the outlook is somewhat better. It is, indeed, considerably better, although, as in the pathological conditions of the brain, its range of usefulness is limited. In all the acute inflammatory conditions of the spinal cord, and in primary spastic paraplegia, electricity is not only useless, but in inflammatory conditions may easily do harm. The function of electricity is to maintain nutrition, and in chronic dorsal myelitis, where the limbs are well nourished and the reflex action excessive, electricity is contraindicated. It over-stimulates the sensory nerves and increases reflex action. It is in the paralysis depending on cornual myelitis—the poliomyelitis anterior both of childhood and the adult—that electricity finds its greatest field of usefulness in structural diseases of the cord. It is only in the early stages that there is any difficulty in diagnosis.

Within ten days, diminution, then complete loss of faradaic irritability supervenes, and this, together with the characteristic

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\* "Observations on Hemiplegia, based on eighty-one recorded cases, with special reference to Cerebral Localization." *New York Medical Record*, April 29th, 1882.

muscular atrophy, renders the diagnosis unmistakable. The faradaic current is alone sufficient for the diagnosis, since complete loss of faradaic irritability is sure to be associated with the reactions of degeneration elicited by the galvanic current alone. Faradaic irritability is lost from many causes, and this complicates somewhat the regional diagnosis. Disease of the grey matter of the nerve roots, the nerve fibres in their course, or of the extreme nerve periphery, all result in loss of faradaic irritability; and this loss, considered alone, simply proves that the nerve endings have lost their susceptibility to faradaic irritation. For this reason, neuritis has not infrequently been confounded with myelitis. The loss of faradaic irritability is the same in the various forms of myelitis and in neuritis, but from very different causes. In myelitis, loss of faradaic irritability is due to the lost influence of the diseased nerve cells on the motor nerve fibre. In multiple neuritis this lost irritability means damage to the nutrition of the motor nerve fibre so profound as to completely obliterate its vital influence. Notwithstanding, however, the similarity of the electric reactions in the two diseases, their other symptoms, both objective and subjective, are so dissimilar that there ought to be little difficulty in distinguishing between them.

Muscular fibre deprived of its nerve supply fails to react under any faradaic stimulation. It reacts only to galvanic stimulation, and the progressive decrease in galvano-muscular irritability indicates accurately the stage of muscular degeneration. In paralysis, from disease of the motor cells of the cord, we find at first, but only for a brief period, a distinct increase of irritability. From the fact that this increase of irritability develops slowly, it is evident that it is due to a progressive degeneration of the nerve endings rather than loss of nerve impulses. If the muscular fibres preserve their transverse striation as indicated by their reaction to galvanic stimulation, there is hope of ultimate recovery, or at least of improvement; but when this reaction progressively grows less and is finally lost, the transverse striations have been replaced by granular and fatty degeneration, and no treatment can hope to be of service.

In interrogating the muscles of children, it is of the utmost importance to eliminate, so far as possible, all pain and even

discomfort if we would make our examinations in comfort and for the best interest of the patient.

The rapid interruptions which make up what is termed the faradaic current does not affect the muscular fibre, but only the more sensitive nerve structure. They give no time for a distinct muscular contraction which becomes tonic rather than clonic. The isolated faradaic shock is not only less painful, but is more effective. This statement in regard to pain, however, refers only to conditions of disease. In health, the isolated faradaic shock causes more pain than when rapidly interrupted. As to the electric treatment of poliomyelitis, both in adults and children, I have no hesitation in claiming for it a decided value—a value beyond that of any other remedy—although in the child there is far more hope of improvement, and in some cases of complete or approximate recovery, than in the adult. Cases of complete recovery of poliomyelitis anterior in the adult, especially if the disease has persisted and has been progressive for a number of months, occurs rarely, and many of those cases that have been reported as such were undoubtedly cases of multiple neuritis, the symptoms of which were formerly so often mistaken for those of cornual myelitis. One great hindrance to the proper and persistent use of electricity in cornual myelitis is the very natural inference based on known pathological conditions. In the disease variously known as poliomyelitis, chronic muscular atrophy and infantile paralysis, the cells of the anterior cornua, in greater or less number, are either supposed to be destroyed or in process of destruction, and it is held to be irrational to suppose that electricity or any other remedy can repair such damage. That electricity is incapable of restoring a cell once destroyed is quite true, but that it is incapable of doing anything to arrest the further progress of a cell on the road to destruction, or of preserving, perhaps, contiguous, healthy cells from degeneration, clinical experience abundantly disproves. I have little doubt that direct spinal galvanization is of some service in aiding nutrition in these cases; that, in a slight degree, the current acts directly on the diseased nerve tissue. This method, however, is powerless to accomplish the greatest good. The vitality of an organ is proportional to the activity of its function, and the cessation of

voluntary functional activity and the loss of electric response tells the tale of cell deterioration. The vitality of a cell is, without doubt, often quickened by artificial excitation of the muscular fibre nourished by it. The vital functions of the trophic cells are stimulated into increased activity, and there is a mutual action and reaction between cell and muscular fibre. Let me repeat that the abolition of all faradaic irritability in these cases does not necessarily indicate that there is marked nutritive impairment of muscular fibre. Absence of response to the faradaic current means damage to the nerve endings, which may or may not result in degeneration of the muscular fibre. Absence of galvanic irritability alone is positive indication of damage to the muscular fibre, and it is the galvanic current alone that in any way influences favorably the nutrition of the trophic cells. It is far better to use no electricity in infantile paralysis without muscular response, than to use the faradaic current, since it is a fact of observation that, used with any persistency or strength, its tendency is harmful.

It is not my purpose to burden this paper with cases illustrative of the value of electricity in poliomyelitis and especially in the infantile form, notwithstanding the wealth of material at hand; but, in closing, may be permitted to present one case, not of poliomyelitis, but of transverse myelitis. I present it not because of a recovery, or anything approaching a complete recovery, but because it illustrates well what I have been contending for; namely, the power of electricity in directly exciting the functional activity of the muscular fibre, to indirectly improve the nutrition and augment the vitality of the spinal nerve cells in connection with these fibres.

The case, a boy, aged 16, was referred to me by Dr. Charles McBurney. Two years before, following a comparatively slight attack of grip he suffered from acute myelitis, associated with paralysis of the sphincter ani, and extreme muscular atrophy. He regained power over the sphincter ani, but the atrophy remained unchanged, and resulted in a permanent luxation of the knee joint, well illustrated in the accompanying radiograph which I was permitted to take.

In testing the muscles of the leg I found, as was to be expected,

an entire absence of response to the faradaic current. To the galvanic current the response was so feeble as to render it impos-



sible to elicit the reactions of degeneration, although it is to be presumed that they were present. But week by week, as these atrophied muscles were submitted to the galvanic stimulation, the

readiness of response increased, the atrophied muscles perceptibly enlarged, and with this enlargement came increased strength. For six months after recovering from the acute attack, this patient had been in an osteopathic institute, and had improved somewhat because of, or in spite of, their peculiar methods of massage; but during the many months preceding the electric tests absolutely no progress had been made. It was impossible to doubt, therefore, that the treatment alone was responsible for this rapid improvement in nutrition.

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#### DISCUSSION.

Dr. G. BETTON MASSEY, of Philadelphia, said that the paper presented an interesting view of the pessimistic and optimistic results of the author's work—the former in connection with hemiplegias, and the latter with cases of infantile paralysis. He knew of nothing more discouraging than to have an old case of hemiplegia sent to him for electrical treatment. There seemed to be a widespread belief that these cases were good enough for the electro-therapeutist. The failure to effect improvement in these forlorn cases had often led physicians to refuse to send other cases which could be relieved, such as those in which there are inflammatory deposits in accessible portions of the body. The speaker said that formerly he had been misled into using electricity freely in cases of hemiplegia, yet he had never seen any benefit, in spite of the most faithful and prolonged treatment. It was important that the general profession should be taught, not only what can be done, but what cannot be done by electro-therapy.

Dr. ROBERT NEWMAN, of New York, said he was sure that Dr. Rockwell and he meant the same thing, yet he was afraid Dr. Rockwell's paper would be misunderstood by the general practitioner. In paralysis due to a blood-clot in the brain, it was evident that the clot must be absorbed before there could be improvement. According to the paper, when the clot is absorbed the paralysis disappears; but it should be understood that this absorption of the clot can be accelerated by galvanic applications. He had often seen cases of this kind treated by the general practitioner by applications of the faradaic current directly to the brain, and as might

naturally be inferred, only with the result of making the patient worse. One must be careful not to over-stimulate. If the blood-clot cannot be absorbed, there will certainly be paralysis of the extremities. It was highly important that the true position of the author of the paper should be made so clear by the discussion that the general practitioner cannot possibly misunderstand him.

Dr. WILLIAM T. BISHOP, of Harrisburg, Pa., said that it seemed to him that the absorption by electricity is equivalent to the alterative or eliminative effect of any other remedy, hence, if the parts are destroyed there is nothing to be taken away or to be built up.

Dr. FRANCIS B. BISHOP, of Washington, D.C., said that he did not entirely agree with Dr. Massey that in cerebral hemiplegia electro-therapy is without avail. If these cases came under treatment sufficiently early, a good deal could be accomplished. Of course, one did not expect to restore the parts that had been destroyed in the internal capsule, but much could be done to prevent the degeneration of the muscles by keeping them stimulated and in proper tone until the clot had been absorbed. It was well known that in right-handed persons a clot on the left side produces hemiplegia on the right side, with aphasia. He had such a case under his observation at the present time. The patient is a clerk in one of the departments in Washington. There had been a haemorrhage into the internal capsule, involving nearly all of the capsule. The contraction of the arm was very decided. The extensor muscles were treated every other day by galvanism, and by the slowly interrupted induced current. At the same time she was advised to educate the other side and learn to write with the left hand. As she progressed in her attempts at learning to write with the left hand the aphasia disappeared. He believed that a good deal had been done in this case by electricity, but he also believed that just as much had been accomplished by educating the other side of the brain. A specimen of this lady's writing with the left hand was submitted for examination.

Dr. MARGARET A. CLEAVES, of New York, expressed her appreciation of Dr. Rockwell's paper. The point there raised as to whether the currents really reached the brain led her to say, that as the conductivity is always by reason of the salts in the

body, and these salts are very abundant in the blood vessels, and the blood vessels are exceedingly numerous in the brain, there was good reason for believing that the electric current does reach the brain. Dr. Cleaves also confirmed what Dr. F. B. Bishop had said regarding the treatment of some cases of hemiplegia. The results were not brilliant, but the occasional good results were certainly very encouraging.

Dr. HENRY McCCLURE, of Norwich, England, said that the author of the paper had truly stated that we could not expect to restore the cells which had been destroyed in the anterior horns of the cord, but it must be remembered that there were other cells which might be prevented from degenerating by proper stimulation. He agreed with Dr. Massey that there was not the slightest improvement from electro-therapy in old cases of hemiplegia. He had seen several cases of long-standing poliomyelitis which had decidedly improved, and he believed that in all cases of poliomyelitis the constant current is indicated.

Dr. MASSEY thought the success obtained by Dr. Bishop in hemiplegia could be explained by the treatment employed other than electrical applications. The case reported was evidently one in which the affected area was high up in the brain, and these were especially amenable to treatment.

Dr. ROCKWELL said that unfortunately the discussion of the paper had been confined to the portion which he considered the least important; *i.e.*, hemiplegia. He had been accustomed to treat the spinal conditions for many years, and could easily present an extensive and interesting clinical array in proof of the results obtained in infantile poliomyelitis. Many of the cases that had gotten well very quickly had turned out to be instances of neuritis.

## High Tension Currents in the Treatment of Neuritis.

By FRANCIS B. BISHOP, M.D., Washington, D.C.

The treatment of neuritis, as well as the treatment of all disease, should, as far as possible, be based upon a knowledge of etiology and pathology. There are certain structural changes in the nerves and the muscles supplied by them, that has been noted for many years, and have been carefully copied and handed down by every author who has written upon this subject. It seems that to discuss the subject of the treatment of disease from the standpoint of electro-therapeutics, it becomes necessary not only to take into consideration the gross lesions, but to consider primarily the changes molecular that there is reason to believe are taking place in the centres in the brain or spinal cord ; especially is this the case in neuritis when the disease comes on in consequence of the overpowering influence of alcoholic stimulants and inorganic poisons, as well as from the toxic effects of diphtheria, scarlet fever, smallpox, etc., and from the infection of typhoid and malarial fevers, and other diseases which are well known to give a parting shot in the form of multiple neuritis. While traumatism appears to exert its influence upon the nerve or nerves injured, it does not seem unreasonable to suggest that a resulting neuritis is the direct product of molecular change in the centres of which these individual nerve fibres are but the continuations. These molecular changes are due to infection from the septic lesion ; there is no evidence of an aseptic wound causing neuritis.

I have been unable to discover any positive evidence that such a condition ever existed as idiopathic neuritis ; a cause exists, whether it can be found or not. We may take diphtheria as a type of disease commonly followed by neuritis, known to too many of us on account of pranks played by the toxines upon the nerve centres of our patients, often at a time when all appeared bright and hopeful. Who among us that have enjoyed a large general practice, has not been appalled by the sudden death of his patient, at a time when all seemed progressing favorably, due to

toxic influences upon the cardiac and respiratory centres. Paralysis of the soft palate is a very common sequel as well as peripheral neuritis, followed by paralysis and wasting of the muscles, more or less severe, according to the intensity of the toxic effect upon the centres; therefore, the neuritis is of degree, and not of kind, and depends for its location in the periphery upon the special centres attacked.

What is true of the toxines of diphtheria is true also of the toxines of other diseases, and the effects may vary according to the intensity and upon the action of the special poison upon the centres in the brain and spinal cord.

Professor Dolbear read a paper before this association in Boston in 1896 entitled, "The Relation of Physics to Physiology," from which the following facts are quoted: "The molecule of protoplasm is made up of a great many atoms of carbon, hydrogen, oxygen, nitrogen and other elements." And again, "The properties of atoms are not alike on different sides; they are allotropic or polarized, and when any given atom is turned around in a given compound, the resultant is changed by the configuration—not because the particular atom has assumed a different property, yet the molecule exhibits a different quality and may have a different function, and this is to be assumed of every atom of every combination." In the light of our present knowledge, we assume all physiological processes to be due to activity of atoms, or a rapid interchange of molecular elements. This activity is going on in all matter, therefore we would expect to find it in the nerve and muscular fibres as well as in the nerve centres themselves, and this is undoubtedly true, but it would be expected to be equally true that the "configuration" of the molecules in the grey matter of the brain and in the spinal cord centres are different from those in the nerve fibres, as the function of the one is to receive and transmit impressions, while that of the other is to carry these impressions to and from the centres. As we have seen, according to Professor Dolbear, that all matter depends for its energy upon its atoms and molecules, and that "all the so-called organs of animal structures are composed of these complex energized molecules, and all physiological functions are but the steps by which this energy is changed from its more concentrated form to more diffused forms,

and there is 'nothing in the whole line of phenomena but a series of physical and chemical reactions,' so to change a physiological function to a pathological condition is only to inhibit the healthy activity of the atoms in their interchange from molecule to molecule, or change the configuration by causing the atoms to change their position in the molecules. As all impressions are supposed to be carried to the centres before they are recognized by the peripheral nerves, so also all poisons in the system, whether from disease or other sources are carried to these centres, and as they are acted upon by the poison the atomic activity is inhibited, or a change of position in the molecules takes place, changing the functions of the molecules in the centres; therefore, instead of transmitting healthy physiological functions to the nerves and muscles, false impressions are received and transmitted, changing the molecular activity of every nerve and muscle under the jurisdiction of the centres involved. Therefore we have numbness, tenderness and pain, loss of motion and wasting of the muscles with change of electrical reactions in the extremities, or where the cardiac or respiratory centres are affected; sudden death quickly follows. If these facts are true, or partially true, electricity, as a curative agent, becomes at once the most rational means of treatment.

As all physiologic and other energies are said to be due to atoms and molecules, so electrical energy must be due to the same prime cause and possesses also the power of directing the movements of atoms in water, in masses of protoplasm or other matter. Every writer whose work I have consulted upon the subject of neuritis, warns against the use of electricity in the early stages, and advises us to begin with a mild galvanic current of from two to five or six milliamperes. These same authors will tell you that you may make sure of your diagnosis by testing for the reactions of degeneration. Now, this cannot be done properly without causing discomfort, to a greater or less degree, in the healthy individual, and it is simply barbarism to irritate tender nerves with a small motor point electrode searching for reactions of degeneration. We find the same reactions in poliomyelitis anterior, and should depend upon the other symptoms for our diagnosis. I am not prepared to denounce the use of the old reliable galvanic current in

the treatment of these cases, for it can be used with great benefit when cautiously applied, but experience has led me to believe that we cannot get as good results as with a high tension current. Galvanism seems to have a selective action upon the protoplasm of muscles ; this is evidenced, or said to be, from the fact that we get the degenerative reaction with the galvanic current when the nerve supply is cut off, and when we fail to get any responses from the current of tension, while the inductive current is said to act directly upon the terminal nerves. In this disease we are dealing primarily with nerve centres and nerve fibres, and it is through these we hope to work—it is upon these we wish to exert the electric energy with the hope that we may stimulate to increased activity their molecular elements, and aid them to throw off the inhibitory influences of the toxins and to resume their physiological functions. The application of galvanism to the course of the peripheral nerve is accompanied by heat localized at the point of contact, accompanied by the accumulations of acid if the active pole be positive, and alkalies if the active pole be negative. If there is a change in the chemical reaction of a diseased nerve, it is due to a change in the atomic arrangement or activity in the molecules of the central organs, and to add more acid to an acid nerve is hardly a reasonable suggestion, and if an alkali is brought directly in contact with an acid nerve we would naturally expect effervescence, in either case it would seem that an increase of pain would follow. These conditions might or might not occur, but are worth our consideration.

By the ordinary method of applying the galvanic current over the course of the nerve and to tender points and stimulating degenerated muscles, the pressure in voltage is quite limited, while the amperage is very great as compared with the high tension current. The galvanic current follows the course of least resistance, and is most intense at the terminals where the work is done in overcoming resistance, and while it follows the law that all conducting bodies within a reasonable area must become charged by induction before the direct lines of energy assume their full intensity, yet the inductive activity of a mild galvanic current is very slight, and must have a very limited effect upon the atoms and molecules in distant parts of the body.

On the other hand, it has been demonstrated to this Association by Dr. Elihu Thompson, at Lynn, Mass., that the high tension current does not always follow the course of least resistance, and it is a common experience that the higher the tension the more difficult it becomes to insulate the conductors, until we get to the high tension currents of our modern static machines, when insulation is almost out of the question. While the inductive capacity is very great, you cannot confine its influence. You may localize its partial effects at the terminals with the high-tension coil, with the static induced with the convective needle discharge, or with the ball and spark ; but in each instance the whole body is charged to the full potential of the machine, and for every vibration that passes between the electrodes, every atom and molecule in the entire body receives a corresponding vibration by induction, and this may be done so easily and comfortably that the treatment is often a source of pleasure to the patient. I have never used the static spark in these cases, as the patients are usually very nervous, and I have myself been rather timid and afraid to subject them to what seemed to me to be a source of local irritation. The higher the voltage and the more rapid the vibrations, the less irritation we seem to have and the more decided the action seems to be in relieving pain. I know of no instrument for measuring the voltage of the static machine, but it is known to be very high.

In the February 12th number of the *Western Electrician* there appeared an article taken from the *Scientific American*, describing an apparatus designed by Mr. John Trowbridge, which he constructed for the study of the discharge of electricity through gases, but he was unable to get results with so low a voltage. This is composed of 10,000 small storage cells, from which he claims to get a pressure of 20,000 volts and eight amperes. This he afterwards transformed into a very high tension current by the aid of Plant's rheostat machine. With this machine he claims to exalt his 20,000 volts to 1,200,000. He says : "I had at first intended to use this large battery in the study of electrical discharges through Crooke's tubes, but I speedily found that X-rays could not be excited by a difference of potential represented by 20,000 volts. I found that at least 100,000 volts were necessary to produce them strongly." This gives me some idea of the voltage I

use in these neurotic cases when it is possible to get them to a static machine. With the small Leyden jars connected by the discharging rod, my current is taken from a shunt on one side of the machine and from the prime conductor on the other, giving me a continuous discharge and sufficient to excite beautifully an X-ray tube, so, according to Mr. Trowbridge, I am charging my patient to the potential of nearly or quite 100,000 volts, and the current is uni-directional, with vibrations so rapid as to appear almost continuous.

One large surface electrode is placed so that it will cover all the cervical and several of the upper dorsal vertebrae; a suitable electrode is placed over the seat of pain or to the extremities affected; the machine is started and the spark gap gradually opened until the patient feels only slightly the vibrations. This treatment continues for twenty minutes.

The first patient treated by this method was a member of my own household, who had suffered with a succession of large boils under the arm and over the distribution of the brachial plexus. These left her with a neuritis, affecting especially the musculo-spiral nerve. The pain was continuous and intense and the arm was useless. In fairness to those who use the spark, I will say that I did not use it, but I did use every other method known to me, with only partial relief to the patient, when occurred to me the idea of using the high tension uni-directional rapid vibrations. The patient sat upon the chair in agony, and in five minutes was fast asleep. I will not detail cases, but will state that I have treated a number of cases of localized neuritis arising from various causes, and always, so far, with perfect success.

Several cases of multiple neuritis, treated at the homes of the patients with the high tension coils, have been steadily improved. An interesting case was one treated with Dr. T. N. McLaughlin, of Washington. The patient was a gentleman about forty years of age, rather a fast liver, and, in addition to the neuritis, the liver could be felt as a hard resisting mass fully three inches below the lower border of the ribs; the abdomen was distended to such an extent as to render the breathing short and labored. This patient had tried the dry heat process and had resorted to Christian Science for some time. Dr. McLaughlin was called in, and did all for him.

that medicine and sound professional advice could do, and I feel deeply indebted to him for his confidence and intelligent support throughout the treatment of this case, which was under treatment about thirty-seven days. At the end of this time the patient was able to walk about, the pains in his feet and limbs had almost entirely disappeared, the liver was materially reduced in size and consistency, and the functions of the body seemed to be going on normally. A large electrode to the spine and another to the feet, with treatment lasting from twenty minutes to half an hour. I would sometimes find him in intense agony and leave him entirely easy.

I have had a number of cases of greater or less intensity and have recently treated all, as far as possible, with the high tension current, and have now a severe case under treatment that is rapidly improving. After sensation returns and the pains and tenderness cease, I sometimes use a mild galvanic current over the muscles with very comforting effect. With the high tension current, notwithstanding the fact that the electrodes are placed upon the body so that the greatest density of current may flow between them, you may pick a spark from any portion of the body by touching the patient, so that not only the centres and nerve fibres in the course of the current are directly under its influence, but every atom of every molecule in the entire body is charged with an electric pressure of several thousand volts, and as they rapidly change under this pressure they gradually throw off the toxic lethargy that has changed their functions, and healthy activity is restored.

With my experience in the use of the high tension current, I sincerely hope no patient will be denied its use in the early stages of neuritis, or any stage.

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#### DISCUSSION.

Dr. G. BETTON MASSEY, of Philadelphia, said that in a number of sub-acute cases he had gotten very poor results from the galvanic current. On the contrary, the spark treatment in the chronic cases had been invariably successful in his experience, and he was convinced that high tension applications were indicated in all

forms of neuritis. He hoped the exact form of current employed by the author would be more minutely described by him. If an interruptor, such as is used for the development of the X-ray, be inserted in the circuit, so that a continuous spark shall traverse the circuit, and the patient be placed on the stool, and the other electrode applied to the skin, there is a different action from that experienced by other applications.

Dr. MARGARET A. CLEAVES, of New York, said she was in perfect accord with what Dr. Bishop had said regarding the value of the high tension current, but she had used the convective discharge and a brush electrode. The application had been made for the general nutritional effect, and also along the nerve. She recalled a case of ascending neuritis with sleepless nights, in which sleep followed immediately on the use of the high tension current. She never used the galvanic current in these cases.

Dr. R. J. NUNN, of Savannah, Ga., said he desired to call attention to a rather loose use of the expression "high tension current." Sometimes it was difficult to know what was really meant by this term. The users of faradic machines speak of a high tension current when they use a 3,000-yard secondary coil. Then there is the Tesla high tension current, and some apply the same term to the static machine current. He thought it would be well if a more exact nomenclature could be adopted by the association.

Dr. BISHOP, in closing, said that he took the current from a shunt on one side of the machine. With regard to the convective discharge, of course, that is a high tension current. He did not claim anything special for the method described by him in the paper further than that it was an agreeable method, and the vibration was rapid. In the case treated in his own household he had used the convective discharge daily with but little benefit, whereas immediate improvement followed the adoption of the method advocated in the paper.

## Electricity in the Treatment of Goitre

By CHARLES R. DICKSON, M.D., Toronto, Canada.

As I have already presented several papers on this interesting subject before the Association; my present contribution will be merely a brief resume of some forms of electrical treatment which I have found most applicable to the various morbid conditions met with in the thyroid gland.

Let me first allude to Exophthalmic Goitre; a systemic disease, in which the enlargement of the thyroid is only a symptom. Here, central galvanization, together with the percutaneous applications over the thyroid, will be found of the greatest benefit. I am in favor of mild currents applied daily, 5 to 10 milliamperes for 10 to 20 minutes, the patient being restricted as far as possible to the recumbent posture, or failing that, to enjoy as much rest as possible.

In engorged conditions of the thyroid I prefer to place the positive pole either on the abdomen or at the shoulders, while the negative percutaneous application is made at the site of the thyroid, 5 to 20 milliamperes for 10 minutes every second day, also employing galvanization of the sympathetic.

In the slighter degrees of hypertrophy I employ an electrode the size of the goitre and cover it with moistened felt, using currents up to the limit of tolerance, 30 to 50 milliamperes or more, 10 to 20 minutes, thrice weekly if bearable.

In the vascular forms, positive puncture, with the platinum needle suitably insulated, from 50 to 150 milliamperes for 8 to 10 minutes, every ten to twelve days, with reversal of polarity, 10 milliamperes for 5 minutes, to loosen the needle before withdrawal, if necessary.

In the larger fibroids I aim at destruction of the tissue by electro-puncture, using chiefly the negative pole, 30 to 50 milliamperes for 10 to 30 minutes, thrice weekly, if possible. I also aim to create an artificial cyst in the interior, which I then treat by hydro-electrolysis, maintaining drainage. Occasionally I use both positive and negative needles in the growth in the larger and more obstinate cases.

In the cystic goitres I evacuate the contents through an insulated canula, and refill the cavity to distention with a saline solution; the canula and solution then form the negative electrode; 50 to 100 milliamperes for 10 minutes. At the conclusion of the seance the cavity is again emptied, a drainage tube introduced, and firm pressure maintained. I endeavor to obliterate the cyst by causing adhesive inflammation of its walls. Care must be taken not to keep up drainage for too long a time, as calcification may occur along the drainage tract, thus keeping a sinus open, which it may be troublesome to cause to disappear.

I have discarded the preliminary hypodermatic injection of cocaine solution at the site of puncture as unsafe and unnecessary.

I have not alluded to diet, hygiene or medication, all of them important factors in the treatment of these cases, as my paper deals with the electrical side of the question only, and even that most briefly.

Electro-puncture of the thyroid, it is hardly necessary to remind you, is a procedure requiring the greatest care.

## Ten-Minute Talks Upon Electro-Therapy.

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### Introduction.

By CHARLES R. DICKSON, M.D., Toronto, Canada.

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In introducing the Ten-Minute Talks upon Electro-Therapy a few words of explanation are necessary.

The prime object of the talks is to set before the general practitioner a few brief pithy statements of "something attempted, something done" in electro-therapy. It is not the intention to endeavor to consider the whole field of Electro-therapy, but only to bring out some points that may be of value in daily work.

Many practitioners tell us that they would use or prescribe this agent, electricity, more frequently if aware of the cases in which it was truly beneficial ; they have gained little or no knowledge of the subject during their student days from their colleges, which have sadly neglected this branch as a rule ; and they have been misled by the charlatan and the over-zealous.

The busy practitioner has little time to devote to the mastery of the intricacies of electro-therapy, and, even if so inclined, knows not where to look for the information he would gain : volts, ohms, milliamperes do not convey to him their true import, watts and joules are usually mysteries, or worse, and meeting such and similar terms in his quest, he is discouraged.

It is intended that the talks shall be as free as practicable from technicalities, suggestive rather than exhaustive ; and, above all, brief and to the point.

## The Action of Electricity on Tissue Metabolism.

*(Ten-Minute Talks upon Electro-Therapy.)*

By WM. J. HERDMAN, M.D., LL.D., Ann Arbor, Mich.

It is abundantly shown by the phenomena that have become commonplace and familiar even to the casual observer and the uneducated, that electricity is a source of energy that is capable of being transformed into other known forms of energy. By means of it we can obtain light, heat, chemical action and mechanical motion. It is only necessary to have a suitable arrangement of matter, which is sometimes called "a machine," by which to bring about these transformations, and the result follows.

The animal organism is made up of molecules and atoms of matter taken from the inorganic world which, while performing their function in the animal tissues, have in no manner changed their nature and properties, but are subject to the same law which they obeyed while a part of the inorganic world as far as their new relations permit those laws to operate. We are justified, therefore, in assuming that the laws we have discovered concerning the action of electricity in the inorganic world are applicable to its action in living organism, and that whenever electric energy is brought to bear upon animal tissues, either for therapeutic purposes or otherwise, its transformation into other forms of energy would take place wherever the composition and mechanism is such in the tissues as to make such transformation possible, and when they are not, the electric energy would escape as such, or remain in the tissues in potential form.

We find in non-living matter that the effect of electric energy upon it varies much according to the form or modality the electricity possesses. The result also varies with the composition of the matter. In a metal serving as a conductor for an electric current electric energy is transformed into heat in proportion as the conductor offers resistance to the current, but if a portion of the path or circuit for the current is composed of a liquid of complex composition a chemical decomposition takes place in the liquid as well as a mechanical displacement of the molecules and atoms composing the liquid.

It is the constant current of one direction, that commonly termed by physicians the *galvanic* current, which is relied upon in the arts for bringing about chemical decomposition and by means of which molecules and atoms in a liquid are mechanically displaced. Other forms of electric modality produce these results but not so readily or in the same degree as the direct current. The animal organism is largely made up of fluid or semi-fluid constituents. Both normal and abnormal tissues have this composition, and it is a demonstrable fact that a direct or galvanic current having such tissues for a portion of its circuit is transformed in part into chemical activities, which result in a decomposition and chemical rearrangement of the constituents of the tissues, and into mechanical movement of the molecules and atoms in one or other direction, according to their polar affinities. These processes resulting from the action of the direct current in its passage through animal tissues we have in electro-therapeutics named *electrolysis* and *phoresis* (*anaphoresis* and *cataphoresis*). We are, perhaps, too much accustomed to think of both these phenomena, chemical decomposition and mechanical transference of molecules or atoms, (*electrolysis* and *phoresis*) as terminal effects of the current; that is, as taking place only in those tissues in the immediate vicinity of the electrodes. It is true, that by reason of the concentration or density of the current at the points where the electrodes are applied, the effect here is greatest; but it must be conceived that the same actions, only in less degree, are occurring all along the path through the tissues over which the current travels. If, therefore, in the midst of the tissues a tumor or an inflammatory exudate makes a part of the path of a direct or galvanic current its constituents are subjected to electrolytic and cataphoric or anaphoric action. The degree of such action and the effect produced upon the abnormal growth in breaking up and liberating the molecules and atoms of matter of which it is composed is proportionate to the strength and quantity and perhaps also to the E. M. F. of the electric current that is caused to pass through it. That decomposition of such abnormal deposits does take place as a result of such transmission of electric currents, of a strength of 20—100 m.a., has been abundantly proven. That the abnormal growth or deposit is thus caused to lessen in size or

entirely disappear without change or injury, other than beneficial, to the normal tissue, as a result of the passage of such a current, is also true.

Just why the electric energy of the strength and quantity mentioned produces a disintegrating effect upon abnormal growths or deposits and is not injurious to the normal tissues is not known with certainty, but it is in all probability due to the fact that the invading abnormal structure has not the stability of molecular arrangement possessed by the normal tissue and is less capable of resisting the influence to change of relations which the introduction of electric energy brings about. Once the molecules and atoms composing the new or abnormal growth are freed from their associations by the electric current then the physiological forces of absorption and assimilation are brought to bear upon them and they are removed or utilized for the building up of normal tissue. It is also quite apparent from clinical evidence that the same current that tends to break down the unstable pathological structure is stimulating and invigorating to the normal tissue protoplasm, for quickened nutrition and growth of this tissue is the result. There is therefore what might be termed a physiological effect upon the tissues subjected to the electric energy in addition to the electrolytic and phoretic effects.

Other forms of electric modality, such as the faradic, sinusoidal, high tension, high frequency, and static induced currents, being for the most part to and fro, or alternating currents, do not at all, or at least not by any means to the same degree, bring about in the tissues the electrolytic or phoretic effects that result from the passage through them of a direct current. But these latter forms of current have upon the tissues a much more pronounced physiological effect. With certain of the modalities, such as that produced by the ordinary induction coil or the faradic apparatus, and that of the low frequency sinusoidal machine, the effect seems to be greatest in transforming the electric energy into the physiological energy peculiar to nerve and muscle structure; for by means of these currents nerve activity is aroused and muscular activity excited with all the results consequent upon their increased function. By them the unstriped muscle in blood vessels, in the intestines and elsewhere, is caused to contract, is improved in

tone, and this in turn quickens nutritive activity and accelerates all functions dependent upon the action of this mobile tissue, while from the same cause the nerve impulses are increased and strengthened and the functions which they control are aroused.

Static charges and the high tension high frequency currents seem to have little or no effect directly upon the molar activities of the animal organism. Their action is more intimate. These electric modalities seem to be correlated more especially to the molecular and atomic movements, and electricity in this form is transformed into these more refined activities of the organism. The effect of these electric modalities is to increase the consumption of oxygen and to quicken assimilation on the part of the living cells of the body, the vitalized protoplasm, while urea and carbon dioxide is eliminated in greater quantity, showing an increase of metabolism. But by them muscular movement is not excited nor nerve action, as such, aroused, for no sensation that is apparent to consciousness in any way announces the presence of these electric modalities when they are present in the organism; yet they possess great therapeutic value, especially in the treatment of such conditions of the system as are dependent upon or attended by defective metabolism, such as neurasthenia, gout, rheumatism, etc.

It must be remembered, therefore, by those who employ electricity as a therapeutic agent, that the choice of the form or modality to be employed in any given case of disease is a matter of the highest importance, for success or failure in the treatment is oftentimes dependent upon a suitable adjustment of the energy to the nature of the pathological process.

## The Galvanic Current in Gynecology.

(Ten-Minute Talks upon Electro-Therapy.)

By G. BETTON MASSEY, M.D., Philadelphia, Pa.

It is by no means easy to compress into ten minutes all that I should say about the value of the galvanic current in the diseases of women, for in spite of a growing conviction of the usefulness of other currents in this class of troubles it remains my opinion that the galvanic current is the most valuable agency in gynecology to-day, and I include all therapeutic measures of whatever character in this comparison. To bring its pre-eminent value distinctly before you I will make the statement that its intelligent application will render four-fifths of the minor and major surgical operations unnecessary in the treatment of ambulant cases of diseases of women.

And I wish to analyze and prove this statement, brief though my time may be, for it comprises the essential question to which I speak.

You will probably agree with me that the great bulk of walking cases in gynecology may be comprised in the following classes : Imperfect development, neuroses, fibroid growths and inflammatory conditions. I do not overlook other physical conditions, but only state that these cover a large majority of the complaints traceable to pelvic conditions for which women will consult you. Now, practically all of these conditions are best treated by electricity as a method of election, and the great bulk may be cured by it.

*Imperfect Development.*—This class includes those numerous cases of scanty menstruation and menorrhagia met with in young girls. Merely vaginal applications of the galvanic current will cure these cases with such a certainty that I regard the prevalent mode of treatment, namely, by dilatation, with horror. And this horror is not lessened when I remember the patients I have seen who were made worse by the dilatation, the violent tearing apart of the uterus leading to ovarian and tubal disease.

*Neuroses.*—Of the large number of neuroses curable by the galvanic current I will not pause to speak, particularly as many of

these conditions are as readily remedied by the faradic, franklinic and sinusoidal currents.

*Fibroid Tumors.*—The Apostoli technic can be confidently expected to cure at least 85 per cent. of fibroid tumors, the remaining 15 per cent. being left no worse and no better. With such a percentage of cases restored to health and comfort by a permanent arrest and reduction, if not disappearance of the growth, it requires an ardent love of the knife to subject these patients to the dangers of an operation in which one out of four will lose their lives and the remaining three be subject to numerous post-operative dangers and discomforts for the remainder of their existences, to say nothing of the sad effects of the accompanying castration.

*Inflammatory Conditions.*—But it is in the chronic inflammatory infections, the uterine catarrhs and hyperplasias and the non-purulent tubal and ovarian inflammations that the most signal value of the galvanic current is shown, for positive cures may be attained in many cases that the surgical enthusiast condemns to the knife. The inclusion of so many affections in the field of usefulness of the galvanic current does not require that we regard it as a panacea, for it should be remembered that we have, after all, but one pathologic condition to deal with in all these affections, namely, chronic inflammation. Whether its seat be the uterus, tubes or ovaries the infected area is capable of being brought within the path of the current, permitting so profound an impression to be made on the trophic and circulatory systems of the affected organ or organs as will induce an interstitial restoration of tissue and resumption of normal function. This power of a merely vagino-abdominal application to remove the congestions, aches and pains of a post infective pelvic disorder, and ultimately to cure it, is due to the peculiar conditions present in this stage of chronic inflammation in which all tendency to a progressive increase of the process has ceased and we have only a persistence of lowly-formed tissue to deal with.

That the galvanic current will redeem the ovary that is affected with this lethargic process is proven by many instances in my practice, and scarcely a month goes by that I am not called upon to rescue either a maiden or a matron from the enforcement of a verdict which lightly consigned these important organs to destruc-

tion. No higher nor more certain work can be performed by this current, and the certain relief that follows mere vaginal applications has made me ponder on a theory that regards mere inflammation of these organs as a justification for their removal—a position that does not seem to be assumed by the profession towards any other part of the body.

#### DISCUSSION.

Dr. FRANCIS B. BISHOP, of Washington, D.C., said that if anyone had the right to speak authoritatively on this subject, Dr. Massey certainly had, because of his large experience. Personally, he agreed thoroughly with all that the reader of the paper had said. Where the condition is purely one of ovarian congestion and inflammation without the formation of pus, his results with electrical treatment had always been excellent. He had been inclined to treat undeveloped pelvic organs by the current from a coil of eight thousand feet of wire, using the tension of the entire coil. The results, he thought, had been better than where he had used the purely galvanic current.

Dr. MASSEY said he thought Dr. Bishop was right about the faradic current often being better than the galvanic. In many cases he had used the galvanic current where there was a lack of development of the pelvic organs, because there was often an associated neuralgia and menorrhagia. He was accustomed to apply the current by the usual vagino-abdominal method. One should not lose sight of the possibility of saving very many women who are now remorselessly subjected to mutilating operations. The pelvic organs are removed, and their removal is justified because there is a little inflammation present, whereas no such radical measures would be tolerated in entirely similar pathological conditions in other parts of the body. It might take prolonged treatment—possibly six months or more—yet he had never failed to cure such cases, and they were entirely within the domain of the general practitioner. The method he advised was the use of a large intra-vaginal positive pole, cotton covered, for five minutes, with a current of fifty milliamperes, the negative pad being on the abdomen. In ordinary cases of metritis, from twenty-five to sixty or more applications were required.

## Some Surgical Uses of Electricity.

(*Ten-Minute Talks upon Electro-Therapy.*)

By CHARLES R. DICKSON, M.D., Toronto, Canada.

My paper is intended to deal with this subject in a very brief manner, avoiding details as far as possible, merely glancing rapidly at some of the many uses to which electricity may be put in the field of surgery. In explanation of the action of this most valuable therapeutic agent a slight allusion to the physics of electricity may be made.

When two needles of some unoxidizable material are connected with the poles of a galvanic battery and thrust into a piece of moist meat, the current being turned on, it is found that a change known as electrolysis takes place in an area surrounding the needles. At the positive pole, oxygen gas and the acid constituents of the tissue collect; at the negative pole, hydrogen and the alkaline or basic portions of the tissue; and the tissue is gradually broken down or electrically decomposed about each needle. The zone about the negative pole is more moist than that about the positive.

When this same process is repeated upon living tissue we have, in addition to the above changes, absorption and other factors brought into play, stimulated by the current. The positive puncture acts as an acid escharotic and the resultant cicatrix is firmer than that due to a negative puncture and more liable to retract. The negative resembles an alkaline escharotic, and the cicatrix from it will be softer and more apt to disappear. The clot around a positive puncture is smaller but firmer than that around the negative.

Many more changes take place also, but the foregoing are sufficient for the purpose of this brief, condensed paper.

Briefly stated, the indications for the use of the respective poles are as follows: To promote absorption, to block up capillaries by bubbles of hydrogen evolved and thereby cause atrophy, and where a scar is particularly to be avoided, employ the negative pole. To remove redundant tissue or to cause artificial thrombosis the positive is used.

The constant current then is capable of inducing irritation, stimulation, derivation, liquefaction, absorption, coagulation or complete destruction of the part acted upon, according to the strength of current used and the method of using it.

In the comparatively mild constant current we have an agent of great value to promote the absorption of exudates before their organization. When dealing with fibrous tissue, however, stronger measures must be had recourse to, and we must now utilize the process of electrolysis. The tissue must be partially broken down and liquefied before absorption can take place.

From this may be judged how wide is the field of electro-surgery. To illustrate, I shall confine myself to one or two uses.

In the treatment of the varied forms of nævus, we have no more powerful nor useful agent than electricity when properly employed. In the smaller and superficial forms we usually insert a needle connected with the negative pole of the battery, while the positive pole is held in the hand or placed on the back. It is possible to cause the smaller nævi to disappear without leaving any appreciable scar. In the larger nævi, especially if there be much redundant tissue, we insert both needles usually, endeavoring to puncture the vessel of supply with the negative needle. This treatment is particularly applicable for nævi situated upon the face or other exposed portion of the body. In nævus pilosus all hairs must previously be extirpated by the cautious use of the negative needle, after which the nævus proper is attacked in the ordinary manner.

Electro-puncture of goitre is frequently a procedure of great utility, to which I allude in another paper, and therefore need not more than mention here.

In papilloma, also, electro-puncture is most potent. When situated in such a region as on the tongue, electrolysis will be found a most convenient and proper method of dealing with it, employing the negative puncture with current sufficiently strong to cause liquefaction.

Hydrocele is another condition in which electro-puncture may be brought into play with good results, the contents of the sac being evacuated through an insulated canula, the sac is refilled with some solution which is a good conductor of electricity,

and acts as an electrode brought in contact with the whole of its inner surface.

In the treatment of old fistulous tracts the fibrous tissue may often be softened, liquefied and absorbed, and adhesive inflammation set up, and the fistula thereby obliterated. In these cases it may not be necessary to puncture, but merely apply a bare metal electrode to the surface.

The foregoing are but a few of the surgical uses to which electricity may be put with advantage; the subject is considered in a general manner only, special surgical uses of electricity being dealt with in other papers of this series of short talks upon electro-therapy.

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#### DISCUSSION.

Dr. G. BETTON MASSEY, of Philadelphia, Pa., said that he differed with the author in the statement that fibrous tissue was not absorbed.

Dr. R. J. NUNN, of Savannah, Ga., said that fibrous tissue is absorbed, but there must be first fatty degeneration before absorption can take place.

## The Combined Use of Electrical and Medicinal Treatment in Some Affections of the Eye.

(*Ten-Minute Talks upon Electro-Therapy.*)

By G. HERBERT BURNHAM, M.D. (Tor.), F.R.C.S. (Edin.), M.R.C.S. (Eng.),  
Toronto, Canada.

This short paper has no pretence to be scientific, but will have fulfilled its purpose if it encourage oculists to be more hopeful regarding their prognosis in certain affections of the eye, and at the same time more energetic and methodical in treatment. With respect to cases of pigmentary degeneration of the fundus of the eye, the prognosis is always very gloomy. The treatment advised is strychnine and electricity. The treatment followed out in these cases has been the same, but in its application there is a difference. Heretofore, if after three or four months there was only a little improvement, its use was stopped. In my cases its use was continued. The reason of my persistence is, if after several months there is an improvement, though slight, then, instead of being discouraged at so little progress, I am encouraged by the thought that if this rate could be maintained for several years there would be, as compared with the condition at the beginning, a marked change for the better. This has been the keynote in these desperate cases. I particularly remember one case of retinitis pigmentosa, in which in one eye there was only feeble perception of light, and in the other very poor vision. This combined treatment, continued for several years, did give a decided improvement, a result far better than I expected.

- I hold that as long as there is any improvement the treatment should be continued. The rate of improvement is often so slow that the amount can only be surely found out by comparing the progress at intervals of one or two months. This remark will show you what I mean by persistence.

In regard to retino-choroiditis, one man I recollect who had V-fingers at 8", who at the end of one year's treatment read  $\frac{7}{8}$ ". It is very necessary to keep up most carefully the use of the

two remedies ; for if one be omitted the progress is lessened or stopped. The electrical and medical treatment seem so inter-dependent that the best result is obtained from their combination. However, I feel the electrical part is the more important. Please remember, I am speaking regarding the treatment of desperate cases alone.

In regard to optic atrophy, especially in children, there has been decided improvement. The change for the better in one case, a boy, was so slow that I simply kept up the treatment through desperation and the mother's willingness to persevere. The boy is now decidedly better, though the vision is still far from normal. So undoubtedly, however, is the improvement that the treatment is going on as long as any can be shown, if necessary for five or six years or more ; that is, in all nine years. Sometimes iodide of potash and iodide of iron are given with the strychnine. The same persistence is also very beneficial in cases of paresis of accommodation consequent upon an attack of influenza ; and, moreover, only in that way do you get a really lasting change. It is also of service in weakness of the internal and external muscles of the eye, where your judgment is that the whole condition, after proper correction of the error of refraction, is due to a want of tone of these muscles.

As the result of five or six years careful watching, the feeling of hopelessness I began with has given place to one of hopefulness, so that now, instead of dismissing the patient with the remark that nothing can be done, or that there is so little hope that it is not worth while trying, I am able undoubtedly to speak more encouragingly. I am very careful to say that a slow gradual improvement can only be looked for, and at the same time, if that is to be had, the medicine and electricity must be used methodically. By persistence in treatment, I mean from one to seven or eight years. Examine the patient's eyes most accurately, so that you can be ready to recognize any small improvement.

I may also mention one case of ophthalmoplegia externa and interna, which has been under treatment for three years. In this case, the improvement in her condition, as compared with her state at the beginning, is decided, though not great. However, by perseverance a good deal can be accomplished at the end of three

years additional treatment, if the same rate of progress can be kept up.

If in desperate cases so much can be achieved by method and persistence, how much more hopeful and energetic ought we to be in the less severe type of these diseases. Ere this combined treatment in this forlorn-hope spirit was begun, Dr. Dickson will recollect that I said to him, if he were willing to try what long, uninterrupted treatment could do in these desperate cases, I was willing to do everything I could. We have acted together, and I have given to you my opinion. Dr. Charles R. Dickson, our President, has always applied the electricity in these cases, and to him I have left any explanation regarding its use he may deem necessary to give.

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#### DISCUSSION.

Dr. C. R. DICKSON, of Toronto—The treatment carried out in the cases cited by the author was chiefly by means of galvanism, the positive electrode being applied to the neck at the level of the seventh cervical vertebra, the negative being held over the closed eye, from one to three milliamperes being employed for from three to five minutes, three times a week.

## Electricity in Genito-Urinary Diseases.

(*Ten-Minute Talks upon Electro-Therapy.*)

By ROBERT NEWMAN, M.D., New York, N.Y.

*Electricity in Genito-Urinary Diseases*, in ten minutes, is a practical innovation for our annual meeting which prevents the exhaustion of a single subject, but necessarily it must be restricted to a retrospect of the literature and general status of the subject during the last year.

*Hydro-Galvanism*.—From different places come new instruments for the use of hydro-galvanism, which do not give new or improved methods, but new forms of appliances.

The instrument of Dr. Kollmann for the stimulative effect in the urethra is no innovation or improvement on former appliances. The length of the tube is not appropriated for an irritable urethra, and the small poles in the tube tend to break the current and thereby the smoothness of the electricity. The writer's instruments for this purpose have fulfilled all indications for applying galvanism to the urethra, prostate and even to the bladder, by a siphon arrangement, thereby only inserting a tube one inch and a half in length.

*The Soluble Electrodes*, by Dr. H. C. Bennett, of Lima, Ohio, a set of six pieces, are here for your examination. They can be used for our purpose and the whole set is sold for the low figure of two dollars. They are similar to others in use, and are described as follows :

The adapter is used to connect both the water and the electric supply to the electrodes which screw on to it.

Two pieces are for rectal treatment. One is for vaginal treatment and electric douche.

One piece for the female urethra, and by admitting enough water to dilate the bladder.

Another piece is used in the male organ. These electrodes are made of hard rubber, and protect the mucous membranes from being injured by coming in contact with any metal. Inside is a copper wire, which carries the current.

"Hydro-Galvanism of the Urethra" was the title of a paper read by the writer, before this Association, in 1895. His urethral Hydro-galvanic instrument devised for the operation has done good service. He prefers a platinum wire inside the tube for electrifying the water, because that metal will not oxidize, and the metallic electrolysis is so small that it is of no importance. The object is to give an electric stimulation to sensitive parts which will not tolerate a direct electrode. Such parts are electrified by the water, without being touched by any instrument.

*Endoscope.*—Of all the urethrosopes or endoscopes in existence there is not one which is free from objections. We need a good endoscope badly, to facilitate diagnosis. The novelty here for your inspection promises to be progressive and useful. The electric light illuminates directly the places to be examined. The instrument is an improvement on Kollmann's urethroscope, which was objectionable because the light was extinguished by the touch with any other instrument. That is avoided in this novelty. The improvement has been made and manufactured by F. A. Reichardt, 27 Barclay street, New York.

*Strictures of the Urethra.*—Treated by electrolysis have been cured just as successfully as formerly by experts. However, the bulk of the profession is not equal to an intelligent understanding of the procedure, and it is amusing to follow the mistakes made.

Authorities even disagree on the pathology of strictures. Some find an inflammation and infiltration throughout all tissues, and therefore cut everything except the foreskin; while others, like Dr. Gouley, deny a deep penetration of inflamed tissues, and say, "There is nothing to absorb."

It is conceded that there may be strictures of different form and size, some even being due only to a contraction of the mucous lining; but most strictures having come under the writer's observation have penetrated the sub-mucous tissues by inflammation, and have formed fibrous tissues or cicatrices, thereby infringing slowly on the calibre of the urethra, and multiplying in time to such a degree that no room is left for the passage of the urine. If such is the case, there is certainly *much* to absorb, and we claim that electrolysis will do this.

Dr. Rockwell's paper, in the *Medical Record*, April 16th, 1898, on "The Value and Limitation of the Electrolytic Treatment," may be misunderstood by some.

Dr. A. D. Rockwell acknowledges that it is wrong to use the positive pole, and that a chemical action does take place and an absorption and softening occurs at the negative pole.

Then he says : "If any one is credulous enough to believe that he can accomplish much by the electrolysis of urethral stricture, etc., " to which the writer answers. Statistics of cures are facts and proven by documentary evidence, investigations, patients and observations of medical men, and these should remove any idea of credulity.

Dr. R. continues : "Benefit follows because of a gradual dilatation through the exercise of force and sometimes, I doubt not, a spasmodyic stricture has been mistaken for a cicatricial contraction." (Italics are mine.)

In answer : 1. My rule is to use no force, only to guide the electrode and let it do the absorption. Proof is, that many times force practices, by different operators, could not advance any instrument, and at the same seance the same electrode passed the stricture in three minutes, with a current of four or five milliamperes. My method excludes dilatation.

2. Spasmodyic action never can be overcome by the galvanic current, because it makes any spasm worse. It is a proof that the contraction was due to a bona fide stricture if it is passed by the galvanic current.

Only a faradic current can overcome a spasmodyic stricture; or, as said before, a galvanic current increases the spasm.

It is necessary to understand the *modus operandi* to be an expert in electro-therapeutics and genito-urinary surgeon ; five milliamperes will do it if managed correctly.

*Mistaken Idea of Improving Newman's Electrode.*—Debedat (*Arch. d'Elect. Med.*, November, 1897) has introduced a modification of Newman's electrical bougie, for which he claims especial advantages. Instead of being wholly metallic, the new instrument is covered with ivory up to its olivary extremity, so that the current passes to the urethra through this part alone. The author uses it in such manner as to produce dilatation without the passage

of a current during its introduction, and electrolysis only while in contact with the strictures in the act of withdrawal. The electrical application is thus accurately limited to a small area. Debedat reports the successful use of the bougie in a number of cases, two of which he summarizes. He concludes that electrolysis by this improved method is a truly curative procedure as regards urethral strictures, which are by it attacked alone without injury to the healthy urethra. None of the cases hitherto observed have called for further surgical treatment. In his opinion, moreover, there is a certain proportion of cases in which electrolysis is the method of election.—*British Medical Journal*, Jan. 22nd, 1898.

This so-called modification or improvement of Newman's electrode shows that Debedat has been imposed upon by an instrument maker who had made a bad electrode, and Debedat changed it to the writer's original design. My electrodes have always been described as *insulated*, except at the extremities—one end the bulb in contact with the stricture, the other for the connection with the negative pole of the battery.

J. Verhoogen, in *Journal de Medicine de Bruxelles*, 1897, No. 421, says: "Electrolysis is of service only at the beginning in the treatment of soft and localized strictures when the patient is pressed for time and desires to be rid of the trouble." This opinion is contrary to all my teaching, experience and reports of facts which have been substantiated.

Dr. R. J. Wilding, of Malone, at the last meeting of the New York State Medical Society, 1898, said that any method of treating urethral stricture that does not tend to *produce absorption* of the abnormal bands about the urethra, must necessarily result in many failures. With this I agree, but I differ in regard to his method of treatment, as I cannot perceive that the introduction of *soft* rubber catheters can cause an absorption.

Dr. H. C. Sample, of Chicago, has written a very sensible article on electrical treatment\* for various ailments, in which he describes well the treatment of electrolysis for urethral strictures, to all of which the writer subscribes, and recommends the perusal of said article.

Dr. G. W. Boskowitz, of New York, has read a very intelligent

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\* *The Medical Brief*, August, 1898, p. 1173..

paper on "Electrolysis in Urethral Strictures," in which he sustains the writer, and says very correctly : " Yet for some reason the profession has failed to appreciate this mode of treatment."

The principal reason is, that the medical profession has not learned " electro-therapeutics," and for this omission our medical colleges are responsible. It is lamentable to see the ignorance in electro-therapeutics of bright young doctors, graduated from some of our best colleges, and the writer has much trouble thereby with internes of hospitals, with which he is connected as consulting surgeon ; his class of trained nurses learn and know more in this science than most members of the profession. A reform will come gradually, but after our demise.

"The Value of Electrolysis in the Treatment of Urethritis Chronica Glandularis," by George T. Mundorf, M.D., New York, appeared in the *Medical Record*, August 20, 1898, which is a good timely article, recommending electrolysis through an urethroscope direct to the diseased glands. The *modus operandi* is similar to the treatment of urethral strictures by electrolysis, using only weak currents to cause absorption.

*Stricture of the Rectum.*—Cases have been reported by the writer in *New England Medical Monthly*, September, 1882, and in a paper read at the meeting of the American Medical Association, held at Newport, in 1889, which appeared in the *Journal, American Medical Association*, May 17th, 1890.

Dr. H. C. Bennett, of Lima, Ohio, has had similar good success, and he reports two successful cases in *Electro Therapeutist*, January, 1898.

The point is, that electrolysis will cure strictures of the rectum, when other means, particularly cutting operations, fail.

*Stricture of the Oesophagus.*—The *Journal of Electro-Therapeutics*, March, 1898, page 83, has an original translation of a paper by M. Giles, Marseilles, on "Application of the Methods used in Treating of Urethral Strictures to Strictures of the Oesophagus," which appeared first in *Revue International d' Electrotherapie*.

He cites a case, treated by Gautier, of a woman 35 years of age. For four years the patient retained no food except milk. The patient was cured in a short time by electrolysis. The same treatment was unsuccessful in a case of spasm, caused by a local cancer.

Dr. Giles has cured with electrolysis a girl 20 years old, who tried to kill herself by swallowing oxalic acid. Another case of probable cancerous origin in a man, 50 years old, was cured by electrolysis, using three milliamperes.

Dr. Foveau de Courmelles made the observation, that progressive electrolysis with metallic olive bulb electrodes and feeble currents, according to Newman's method, has proved its value in the urethra. It has been employed with success in oesophageal stricture.

*Electricity in Incontinence of Urine.*—Capriati\* (*Edinburgh Medical Journal*) records a case of involuntary enuresis successfully treated by means of the currents introduced into medicine by Morton, of New York. These are known as induced static currents and are furnished by the oscillatory discharge of Leyden jars connected with an electrical machine. The patient is not insulated, but is connected with one of the jars, while the other is connected with the earth. The intensity of the current is regulated by merely altering the distance between the jars. Capriati's patient was a previously healthy man of thirty-five, who was gradually attacked by weakness and wasting in the left leg, with club-foot and exaggerated knee-jerk on that side. There was no reaction of degeneration, but incontinence of urine was very troublesome. The author considers the symptoms to point to limited lesion of the spinal cord in the lumbar region. After several experiments with different currents, Morton's currents were used in conjunction with the spino-perineal galvanisation. Immediate relief followed, and after the treatment had been carried out every other day for two months, cure was complete as regards the incontinence.

*The Prostate.*—The treatment of the hypertrophied prostate by the Galvano-cautery, Bottinit (*Archiv. für Klinische Chirurgie*, 1897, Band liv., Heft I.) claims for the operation the following points : (1) The unmistakable efficiency of the operation—a patient who has not urinated for years passing his urine voluntarily a few hours after the operation. (2) The harmlessness of the operation, even in patients over 80 years of age with foul urine. (3) The permanency of the cure, no case as yet having been known to

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\* *Charlotte Medical Journal*, July, 1898.

† *Medical Record*, April 30, 1898.

recur. (4) No post-operative bad effect or effect upon the morale of the patient. (5) The operation is painless, and can be done without anaesthesia.

"Bottini's Galvano-Caustic Radical Treatment of Hypertrophy of the Prostate," by Willy Meyer, M.D., is the title of an exhaustive paper in the *Medical Record*, March 5th, 1898, page 325.

The late Dr. Guleke had imported an original Bottini instrument, with which he and myself operated in the years 1882 and 1883. As the results was not entirely satisfactory, I constructed for the treatment of hypertrophied prostate, my galvano-cautery sound, which was demonstrated in a paper read in the Surgical Section at the thirty-seventh annual meeting of the American Medical Association at St. Louis. The paper was published in the journal of the American Medical Association, August 28th, 1886. This instrument, in a new garb and improved, was exhibited in a paper read at the International Medical Congress, September 8th, 1887, in Washington, entitled "Galvano-Cautery Sound and its Application, Especially in Hypertrophied Prostate." It was published in the transactions of the International Medical Congress as well as in the *New England Medical Monthly*, December, 1887.

In these papers I have described the Bottini method, given my full appreciation, and also stated the objections. Some of the latter have been removed recently by a modification of the instrument by Doctor Freudenberg, of Berlin.

Bottini performed his first operation October 26th, 1875.

Our honorary fellow, Dr. Bruce Clark, of London, reported a case on which he operated with the Bottini instrument to the International Medical Congress, Berlin, 1890.\*

Prostatitis, or even hypertrophy, may also be treated by hydrogalvanism or Electrolysis. Either application may be made through the urethra or per rectum, which methods may be used alternately.

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\* My own and Dr. Guleke's operations in 1882-83 with the Bottini method and original instrument not being satisfactory, have not been especially reported. That fact explains Dr. Willy Meyer's statement, "that the Bottini operation has never been performed in this country." I therefore mention the fact. If I had not performed Bottini's operation I would not have been able to criticize it, nor would I have devised my Galvano cautery sound, which has worked very satisfactorily.

It must be performed with great care and a weak current used, so that no pain is caused. In all cases the hyperesthesia and spasmodic action can be allayed by applications of the high tension faradic current, which instrument is made by the Jerome Kidder Manufacturing Co.

Mild galvanic currents have been used in chronic urethritis. Galvanism has also been recommended in syphilitic ulcers and buboes and medicines given by cataphoresis. In chronic orchitis galvanism has been recommended by the positive pole over enlarged testes, and the negative pole over spermatic cord, with a current of five milliamperes.

## The New Cataphoric Treatment of Cancer.

(*Ten-Minute Talks upon Electro-Therapy.*)

By G. BETTON MASSEY, M.D., Philadelphia, Pa.

Since my presentation to you of the subject of the cataphoric destruction of cancer cells at the last annual meeting, the estimate then expressed of the value of the electric dissemination of mercuric oxychloride from gold instruments has been justified by the cure of five cases, three of which were carcinomas, situated respectively in the breast, tongue and sublingual gland. The two sarcomas were, respectively, of the upper maxilla and the right groin.

This may be considered a small number of cases to fortify the claim I advance that this method is the most important discovery yet made in the therapeutics of malignant diseases, but when it is considered that these were nearly all of the suitable cases seen by me during the year, and that the remainder of this class is still under treatment with promise of cure, the value of the demonstration is by no means small. There have been several failures to arrest the malignant process in the same time, but these failures were invariably in cases in which metastatic deposits were existent before the beginning of the treatment. The local conditions in these disseminated cases were either temporarily improved or completely controlled during the remainder of the lives of the patients, which were terminated by the unarrested progress of deposits in internal organs made previous to the treatment.

*It should be understood that while my method necessitates the use of electric currents it is totally unlike any other electric treatment of cancer. The electricity is used merely as a carrier of a material, or materials, which act as a protoplasmic poison when brought into contact with the protoplasm of the cancer cells, the value of the electric convection being the ability thus gained to cause a molecular union of the substance with the protoplasm of all the cells that lie near the instrument within the radiating lines of current flow between the penetrant electrode and dispersing pads. As a result, the cells of the malignant tissue are devitalized, and either cast off or absorbed, while the cells of surrounding normal tissues are able to*

resist in great part the atomic invasion by reason of a sturdier vitality, the final result being a re-awakening of their physiologic resistance to the cancer dissemination.

A double effect is aimed at—the destruction of the malignant cells and the recrudescence of the forces of the body that resist their invasion.

The harnessing of one of the forces of nature for the conveyance of protoplasmic poison into cancer cells enables us to thoroughly impregnate a growth at a single sitting from one or more electrodes placed within it, it being only necessary to use sufficient electric energy to convey the quantity suitable to the case, and to time the application so that the most distant prolongations may be reached. I scarcely need say to this audience that these two facts, viz.: the quantity of a chemical carried by a current, and its speed of progression, are physical laws well determined in pure physics and in the practical arts of electro-plating and electric manufacture of chemicals, and that these laws apply to the living human body with the same precision as to other electrolytes of dead substances containing a similar proportion of water.

An additional practical point remains to be mentioned that is of great consequence in comparing the merits of this method of cancer-cell destruction or removal with any other directed by the unaided efforts of the operator. The prolongations and peripheral invasions of both carcinoma and sarcoma are often of so subtle a nature as to evade recognition by the operator; such paths of extension are, however, better conductors of electricity than surrounding healthy tissues by reason of a greater preponderance of water-containing cells, and are therefore specially traversed by the chemical laden current, and thus receive a greater dose of the lethal substance. The electric or cataphoric transmission of lethal substances enables us, therefore, to do a more thorough extirpation of a malignant growth, while the sound tissues of the region are saved from the wholesale removal now the rule in knife operations.

Turning to the general details of the method, it should be stated that the process involves the placing of an electrode or electrodes within the growth—or possibly merely in contact with ulcerated surfaces—this electrode being constructed of solid gold,

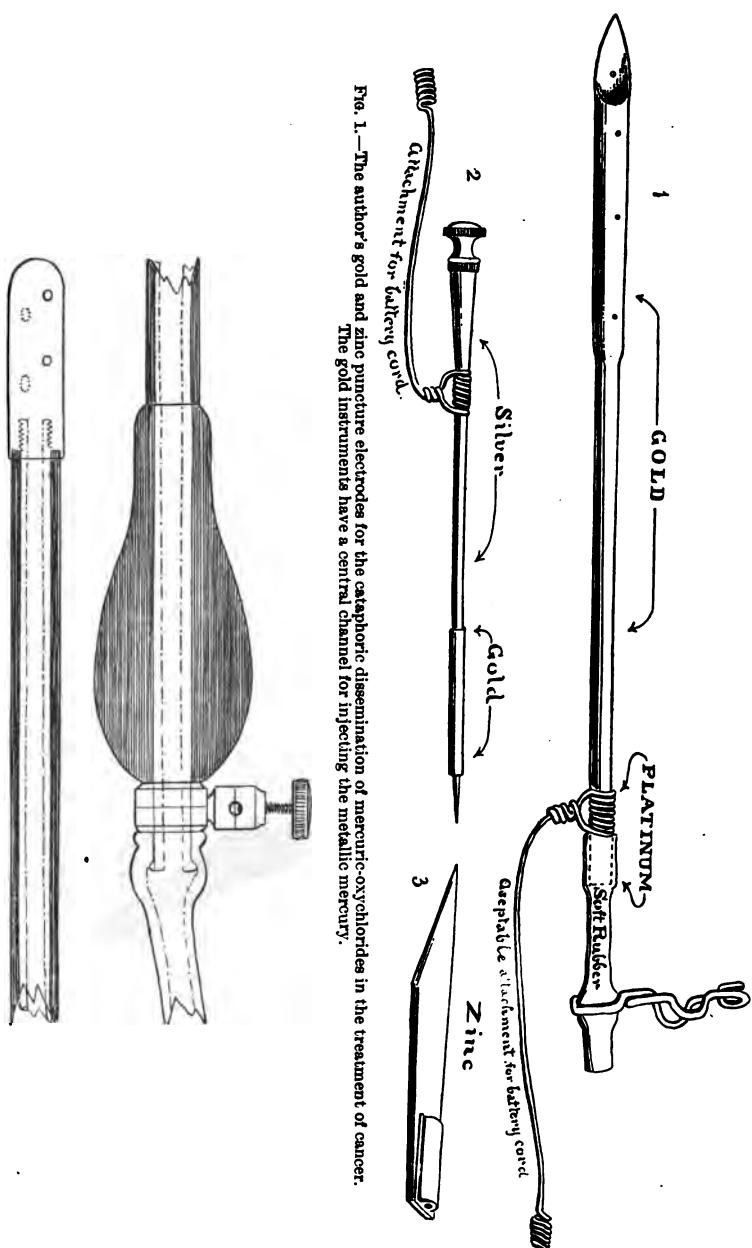


Fig. 1.—The author's gold and zinc puncture electrodes for the cataphoric dissemination of mercuric-oxychlorides in the treatment of cancer.

Fig. 2.—Bulbous channelled gold electrode for dissemination of mercuric-oxychloride in application to cancer within cavities.

coated and surrounded with metallic mercury, or composed of other effective materials (Figs. 1 and 2), and made the positive pole of an appropriate current, the indifferent pole being a very large pad covering an area of skin equal to the whole surface of the back of the patient. The current now being turned on gradually and



FIG. 3.—The Massey Transportable Galvanic Battery. This battery has been designed to furnish from 350 to 1,500 milliamperes for a sufficient duration, when two are coupled together in series. The elements are raised and lowered by spiral worm action, actuated by a crank, and all parts are designed for durability under heavy currents.

without shock, through a controller, electrolysis occurs at the electrode situations, the oxygen and chlorine anions appearing at the gold electrode attack the mercury, producing an oxychlorid, which now, becoming a cation, is repelled by cataphoric action from the gold

electrode through the tumor along the lines of current flow, invading and destroying the protoplasm of the malignant cells in an increasing ellipse toward the opposite pole. From 350 to 1,200 or more milliamperes will be required in average cases, and all portions of an average growth will be reached in from fifteen minutes to an hour. Complete anaesthesia is usually required.

During the passage of the current the mercury will disappear from the gold electrode unless it is kept supplied by injection through a channel within it. In a few moments a marked change occurs in the cancer—easily seen if the growth be on the surface; it blanches and becomes shrunken, and an area of necrosis shortly appears about the electrode. Increased heat is evident if the area of the active electrode is small, though this is never sufficient to burn. If there has been any odour emitted from the growth or ulcerations within it, this now ceases, never to return if the application is sufficient to arrest the growth. All pain, also, is removed at once unless the application be overdone, when the normal tissues will show a pain reaction for several days. The small slough is thrown off in from ten days to three weeks, together with considerable watery drainage, and healing by granulation is usually complete by the end of four to eight weeks.

It is evident that this method is only applicable as a curative agency to growths that are still local, or with infected glands in a situation to be reached directly, though its use as a palliative in incurable cases has much to commend it.

The dissemination of the mercury is so gradual and massive when strong currents are employed that the lymphatics and veins are sealed before it, permitting applications to the most vascular tumors without the loss of a drop of blood. This sealing of the absorbents at the periphery of the growth is of great advantage also over cutting operations, in that it is impossible to make such an application a menace to the patient by the transplantation of cells to fresh surfaces, as has been alleged of cutting operations. Only a minute quantity of the disseminated mercury reaches the general circulation.

## DISCUSSION.

Dr. MARGARET A. CLEAVES, of New York, asked if any observations had been made on the urine, to demonstrate the presence of mercury in the body.

Dr. MASSEY said that several of his patients had complained of tenderness about the gums, and unquestionably a number of them had been very mildly salivated. In several cases he had endeavored to recover the mercury from the urine by electrolysis, but this attempt had failed. If the mercurial cataphoresis be tried upon a piece of meat, it would be found that the mercury was carried in only to a limited distance—three or four inches.

## Orthopædic Uses of Electricity.

(*Ten-Minute Talks upon Electro-Therapy.*)

By LOUIS A. WEIGEL, M.D., of Rochester, N.Y.

There is no distinct branch of electro-therapeutics which is applicable to orthopædic surgery. In cases of infantile paralysis the function of the orthopædic surgeon is supposed to be directed to the correction of existing deformities, or to preventing the occurrence of such deformities. The neurologist often makes the mistake of treating his cases by electricity, irrespective of the mechanical conditions present. As a consequence of disturbed equilibrium, deformities are almost sure to follow, and hence, while electricity is a useful adjuvant, if only one method of treatment can be employed, the more important one is the mechanical one. In most cases of spastic paralysis operations are necessary. In most cases of lateral curvature, electrical stimulation of the muscles is a proper adjuvant. In the painful affection of the foot known as metatarsalgia, Morton claims that there is a pinching of the nerve by a breaking down of the arch. None of the radiographs that I have made showed any such pinching. Flat-foot is another condition in which electricity is a useful adjuvant.

*Exhibition of Radiographs.*—(1) From a case in which it was a question whether the pain was due to injury of the bone, or was of nervous origin. The radiograph showed that the inquiry was confined to the soft parts. (2) Old fracture of the tibia, in a case in which there was much pain about the ankle. (3) Injury to the foot; a case of so-called chronic sprain of the ankle. (4) Complete sinking down of the os calcis and a flattening of the whole series of tarsal bones; in other words, a typical flat-foot. The radiograph served to distinguish between true flat-foot and the pronated foot. (5) Showing the horizontal position of the os calcis. (6) Fracture of the lower end of the humerus. (7) Impacted fracture of the radius a week or two after the injury, showing how well the bone was held in position. (8) Fracture of the fibula, showing an un-united fracture of about eight weeks' standing. (9) Radiograph from a case in which a diagnosis of fracture of the styloid process

of the ulna had been made, yet recovery did not take place for a long time. The radiograph showed complete fracture of both radius and ulna, and an area of inflammatory infiltration throughout the whole carpus. (10) A radiograph showing the typical appearance of hip-joint disease in the third stage. It was taken from a child who had had typhoid fever. The radiograph showed a spontaneous dislocation of the femur on the dorsum of the ilium, occurring during the course of the typhoid fever. (11 and 12) Radiographs from a case which would be classed as birth palsy with obstetric paralysis. They showed that the case was one of congenital dislocation of the shoulder joint. (13) Double congenital dislocation of the hip, and exhibiting plainly the extent to which the acetabulum had been destroyed. (14) Radiograph from a case of old hip disease, showing the valuable assistance rendered in making a prognosis. (15) A radiograph of a similar case, but showing the amount of disturbance of growth in the ischium. (16) Radiograph from a case of Pott's disease in the upper dorsal region. (17) A case of old disease of the knee joint. (18) Radiograph of the knee, which was apparently ankylosed. It showed distinctly that there was neither bony nor fibrous ankylosis, and that the resistance was entirely muscular. This was afterward proved by placing the patient under chloroform, when the knee straightened out perfectly. (19 and 20) Showing a normal and an abnormal carpus. The abnormal one showed the condition found in rheumatic fingers. (21) A radiograph showing the early stage of arthritis deformans. (22) Radiograph from a child, seven days old, showing double congenital club-foot, congenital dislocation of the hip and club-hand. (23) Showing the actual condition present in lateral curvature of the spine. A radiograph properly made, constitutes an excellent means of accurately recording improvement in such cases.

I have used the static machine for X-ray work for a year and a half, and have yet to see the slightest X-ray burn. The exposures have varied from forty-five minutes to one hour. Every one of the radiographs exhibited has been made with the static machine, and in none was the tube nearer than eighteen inches. This I consider to be the secret of my immunity from such incidents.

## The Functional Neuroses, with Special Reference to Neurasthenia—Their Pathology and Treatment.

*(Ten-Minute Talks upon Electro-Therapy.)*

By A. D. ROCKWELL, M.D., New York, N.Y.

In no classes of diseases perhaps are stereotyped methods of treatment—either medicinal, electrical or hygienic—of less avail than in the functional neuroses.

Every practitioner is liable to fall into certain therapeutic ruts. No one, for example, doubts the efficacy of the rest cure in many neurasthenic cases, nor can one doubt its inefficient and even injurious effects in many other cases.

Neither rest nor active exercise, nor fasting, nor stuffing, can be indiscriminately prescribed with any hope of hitting the mark except in occasional cases. It is difficult to tell where the nervous condition ends and the toxic begins; to discriminate between cell exhaustion and the irritability that arises from the imperfectly transformed products of digestion. Close observation is required, and a careful study, not only of the present condition of the patient, but of his past, his method of life, and his heredity.

Various conditions, again, that we are accustomed to classify as nervous do not in reality come under that head at all; are not due to pathologic changes beginning in the nervous tissues. Hemiplegia—cerebral softening—even chorea and epilepsy in many instances do not belong to the true neuroses. The causes are mostly arterial causes. In hemiplegia especially, it is a question of arteries, and in many choreic and epileptic cases, where the parents have had hemiplegia there is necessarily no nervous diathesis to be taken into consideration.

The true unadulterated type of nervous disease is found in those conditions where there are no arterial causes, and where the arterial symptoms are of secondary importance and consecutive to nerve derangement.

Under this head we must class neurasthenia, in my estimation the most important of the functional neuroses, and to which I propose mostly to confine my remarks. It is coming more and

more to be understood, that in dealing with this hydra-headed condition we are dealing with a derangement of cellular nutrition, as positive, and in the majority of cases, perhaps, more persistent than when brought about by microbic agencies.

Neurasthenia, in its more frequent aspect, is simply fatigue—normal fatigue, if you will—carried to excess.

Electro-physiologic experiment teaches that if, either directly or indirectly, we electrically excite a spinal ganglion, we get a shrinkage of the nerve cells which continues for many hours, and persistent stimulation may utterly destroy the life of the cell. It is at least rational to suppose that a similar pathological change in the nerve cell takes place under the stimulation of the varied activities of life, exhaustive mental efforts, and especially the stress and strain of abnormal emotion, and early sexual abuse. Normal fatigue in these directions permits a ready recuperation ; pathologic fatigue, however, does not permit a ready return of nerve and muscular tone to the normal level, and when repeated and excessive, results in permanent exhaustion of the nerve cell. "A man is as old as his arteries," and, barring accidents, it is almost impossible for one to die whose arteries are structurally sound. He who suffers from arterial degeneration may, and usually does, live comfortably and die suddenly ; while the neurasthenic, with his healthy arteries, lives most uncomfortably and dies slowly. If it were not for one fortunate favoring factor, it may be a question as to the choice of these two conditions. I refer to the curability of the one and the incurability of the other.

Notwithstanding its factor of pathologic fatigue, neurasthenia does not necessarily mean mental exhaustion, for many neurasthenics are capable of sustained intellectual effort. It does not necessarily mean physical exertion. It is indeed by no means rare to meet neurasthenics who can, without distress, perform unusual work of brain and body. This seeming paradox has greatly perplexed students of this disease ; and, more than any other fact of observation, has led them to doubt the existence of any such disease as neurasthenia. That one nervously exhausted can still be equal to severe mental exertion seems to be a contradiction of terms. If, however, we take into account the reserve forces of the body, we find a partial solution of the problem.

The neurasthenic has, to be sure, but a small amount of reserve nerve force as compared with the perfectly strong and healthy man, but what reserve force there is, is expended rapidly and vigorously, and results in a more effective and correspondingly larger amount of work.

Profound exhaustion may result, but in the same ratio as the expenditure of force is more rapid in the weak than in the strong for the production of the same degree of profound exhaustion, so in the same ratio food and repose renew more rapidly this temporary loss of force in the neurasthenic than in the strong and healthy. This capacity of doing effective and original work on a small amount of nervous reserve force, I have in my own experience seen illustrated time and time again, and the history of literature abounds in evidence that much of its best and most original production has been the work of neurasthenics. But if neurasthenia does not always mean mental and physical exhaustion, it does invariably mean a more or less profound perversion or disturbance of morale, with marked psychical and sensory symptoms.

Now, in these cases the question is often asked, does electricity do good, and if so, how? The neurasthenic appears as a rule to be well nourished. He frequently gains weight; his color is good and his appetite often first-class. But is he well nourished? How can he be well nourished with a nervous system so erratic and unstable that the slightest influence, a casual glance even, is sufficient to so disturb the vasomotor equilibrium as to cause a general nervous disturbance, as manifested in the flushed face, perspiring hands, eyen dizziness and perverted vision. The neurasthenic is not only not well nourished in the true sense of perfect nutrition, but there is a good reason to believe that he may suffer from toxic influences, which may be both a cause and a result of the undoubted malnutrition of the nerve cells. If there is a disease more aggravating and humiliating to its victim, I have never encountered it. The symptoms are, as a rule, entirely subjective, and to those whose good opinion and sympathy the neurasthenic most covets, he is too often a living lie, and in my own experience more than one suicide has resulted, not alone because of the

suffering from the disease proper, but because of the utter isolation and hopelessness entailed. The first necessary step in the process of relieving a neurasthenic is to gain his confidence, and this you can only do by recognizing his infirmities, and treating them with consideration, sympathy and respect. There is no stereotyped method of treatment. We cannot well get along without judicious medication. The weak and erratic nervous system must be temporarily sustained and soothed, while the patient is profiting by the slower processes of hygiene and electricity. On some one of the various bromides, including the bromide of zinc, either alone or in combination with belladonna, cannabis indica, etc., according to individual idiosyncrasies, it has been my habit to rely more confidently than upon most other combinations. But it is to electricity that I turn for the best results that therapeutics is capable of yielding, in this tedious and distressing neurosis. If it be true that neurasthenia is a disease of exhaustion, of impaired nutrition, then theoretically electricity ought to be of service since, as an aid to nutrition, its position is sufficiently assured, and practical experience certainly teaches one that electrification is altogether the most powerful means at our command in the final restoration of perverted cellular nutrition. If I were speaking to men practically unfamiliar with electro-therapeutics, it might be expected that I would specially indicate the kind of current and the methods of application, but those who are familiar with the subject know well that this is not altogether practicable. Our experience teaches us that there is no remedy, to the effects of which there is a more varying degree of susceptibility, and especially with neurasthenics a well kept record of cases will show a most remarkable variety of conditions. Consider, for example, the difference in susceptibility to the galvanic current. There are cases where anything over ten or fifteen milliamperes on any part of the body seems to provoke irritability, while one-half this strength applied to the head becomes decidedly disturbing.

On the other hand, there are neurasthenics whose very disease seems to make them equal to the endurance of unusual strength of current, which it is found necessary to decrease as improvement progresses.

These remarks apply to the other manifestations of electricity. It is perhaps hardly necessary for me to call attention to the fact that it is impossible always to predict whether it is a faradic or galvanic, static or sinusoidal form of current that will give the greatest satisfaction and the best results. The patient comes to know sometimes—far better than his physician—what agrees and what does not agree with him. If we are wise, we will in these cases, like astute political leaders, who “Keep in the van by recognizing where the people are dimly minded to run,” keep the confidence and direction of your patients, by quickly divining their well-founded preferences. Among the occasional symptoms associated with the malnutrition of neurasthenia are disturbances of circulation. This instability of the circulation is more especially noticeable in the extremities. They become hot, then cold. I have seen cases where the hands, feet and face, under emotional causes, change within a few minutes from normal to marked sub-normal heat. This sudden fluctuation results in internal congestion; the kidneys especially suffer, and I have in my records a number of cases where albumen and casts have appeared, consecutive to long-standing neurasthenia of this type. I cannot speak too highly of the action of static electricity in these conditions. The circulation is equalized, and equally as a tonic and sedative, its good effects are not slow in manifesting themselves. In connection with prolonged applications of the induction current of high tension over the kidneys, I have observed in several instances the disappearance from the urine of both albumen and casts.

Static electricity, together with other forms of electrization, is more than a mere tonic or sedative. They act as eliminators of poisonous principles.

Now, I believe that there are forms of neurasthenia and insane conditions in which toxins may enter almost entirely as causative factors. Through poisons circulating in the blood the neurons become affected, and whether the disease is organic or functional, is here, as in other conditions, the important question.

Neurasthenia is in the majority of cases functional and generally curable, while insanity is probably, in the majority of cases, organic and therefore incurable. But insanity is sometimes curable, which suggests a purely functional derangement of the nerve

cells; while neurasthenia may be incurable because of a chronic organic condition brought about by toxic causes. If this be true, it emphasizes the importance of early treatment.

Not only does electricity directly influence nervous action through the vasomotor system, but it excites vital function by acting directly on the cell itself and on the protoplasm, thus hastening nutritive changes and cellular activity; excretion is stimulated and poisons eliminated.

In further explanation of the rationale of the therapeutic action of electricity, the discovery and suggestions of M. Edouard Branly, professor of physics in the Catholic Institute of Paris, if not conclusive are at least interesting.\* As I have up to this time seen no English translation of this discovery in physics, I may be permitted to briefly allude to it and to its possible relation to the pathology and treatment of the functional neuroses. Through no possible interpretation could it have interest for us on the old theory of the anatomical continuity of the nervous system, but in the light of the discovery of the neuron, by which we find the nerve tissue made up of distinct and disconnected elements, it immediately becomes worthy of consideration.

Briefly stated, M. Branly discovered that if a tube of iron filings be placed in a weak galvanic circuit, the meter fails to register, thus showing that the substance is practically non-conducting. If, however, the tube is previously placed in a solenoid through which course currents of high frequency, or is simply subjected to the influence of static electricity, or of the cathodic ray, the tube immediately becomes a conductor, and the current passes. Subject the tube with its contents, however, to some sudden shock, as that of a static spark or blow, and its conductivity becomes immediately annihilated.

Various theoretical considerations, unnecessary to consider here, are advanced in explanation of these phenomena.

They may or may not be the true solution of this mysterious happening, but we certainly see a similarity between the individual iron filings of the tube and the individual neurons of the nerve substance, and a striking analogy between them in their relation

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\* See *L'Actualite Medicale*, December 15th, 1897; *Archives d'Electricite Medicale*, February, 1898; *Revue Internationale d'Electrotherapie*, March, April and May, 1898.

to electric energy and shock, which may throw light not only on physiology, but on the cause and cure of the functional neuroses. It is well known that we can hasten the recovery of hysterical paralysis by placing the patients in an electro-static field, or subjecting them to the influence of currents of high frequency coursing through a solenoid, as well as by other forms of electric energy. The analogy between the two—the tube of iron filings and the nerve structure—may be carried still further, since the restored nervous conductivity in a case of paralysis of hysterical origin may be instantly annihilated, as is the electric conductivity in the tube of iron filings, by sudden shocks.

"Does not this help to make clear to us the characteristic causation of hysterical paralysis? Does it not reveal the traumatism which produced them? Moral or physical traumatism, emotional shock or railway accident, psychical influence or injury, brutal application of physical agents, heat, cold, light, etc., in fact, all violent excitation is capable of producing loss of conductivity of the nerve current proper in or through the neurones, as it can restore it when abolished.

"Certain cases of hysterical paralysis, confined to bed for months or years, have suddenly regained power when some violent neuro-motor excitation, such, for example, as a sudden conflagration, has overcome the non-conductibility of the neuron."\* Whether or not this discovery of M. Branly is sufficient to furnish the key, as its enthusiastic advocates suggest, to the cause and cure of the functional neuroses, it at least opens up a novel and interesting field of research.

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\* *Revue Internationale d'Electrotherapie*, March, April and May, 1898. M. Guimbal.

## Alternating Dynamo Currents.

By FRANCIS B. BISHOP, M.D., Washington, D.C.

At our Toronto meeting, Professor Herdman introduced the subject of the alternating dynamo currents as a therapeutic agent. Several interesting cases were reported as successfully treated. Within the last year I have been fortunate enough to get the alternating current in my office. This is transformed from 1,100 volts to 104 volts. I use it to run a motor to turn my static machine, lighting my office, running electric fans, etc. The principal objection to its use for mechanical purposes is that, so far, there has been no economical speed regulator invented, therefore the speed has to be regulated by the size of the pulleys on the machine. I have recently placed in my office a transformer, made for me by Messrs. Waite & Bartlett, of New York. This reduces my voltage from 104 to four volts, and gives me practically a sinusoidal current of 16,000 alternations per minute. By this instrument, the current may be turned on very gradually from zero to the full capacity of the apparatus. It is a perfect machine for light cautery work. The sensation of the current in moderate strength is very pleasant.

This current may be passed through the high tension combination coil with all the variations to which the coil is susceptible. In using it in this way the vibrator is usually screwed down; but if the current is allowed to run the vibrator, using the full length of the coil, the tension of the current is much higher than when the vibrator is screwed down; this can be demonstrated with the Geisler tube, which also shows the current to be purely alternating.

What the special therapeutic properties of this current and its various modifications are, I am not yet prepared to say, but I imagine that its range of therapeutic usefulness is very great. I should think that it would meet nearly, or quite, all of the demands of the sinusoidal machine, as well as giving us a high tension alternating current.

Dr. Herdman spoke of a number of pathological conditions which were favorably influenced by the aid of this current. I

hope that he will give us the benefit of his further experience. I have treated a few cases with the aid of my transformer, but the time has been too short to record results. Two cases of writer's cramp have been greatly benefited by this current.

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#### DISCUSSION.

Dr. G. BETTON MASSEY, of Philadelphia, Pa., remarked that the author had not made it clear just what apparatus he used.

Dr. BISHOP replied that he used a transformer of the step-down type, which reduced the voltage from 104 to 4 volts. The method used in the cases of writer's cramp consisted in placing both hands of the patient in jars containing warm water in which salt or soda had been dissolved.

## The Alternating Current.

By G. GAUTIER, M.D., and J. LARAT, M.D., of Paris, France.

Since we proclaimed the usefulness of the alternating current, in 1893, and chiefly its generalized applications in the form of hydro-electric baths, we have had the satisfaction of seeing our method adopted by a great number of electro-therapeuts, as well in France as in Switzerland, Italy, Belgium, etc. The favorable influence of these baths on rheumatism, gout, anæmia, neurasthenia, and on a great number of nervous troubles, muscular atrophies, has no more to be proved.

We wish to-day to call the attention of the practitioners to the influence of hydro-electric baths on certain diseases of the digestive organs, and particularly on those of the stomach. We shall speak first of all of the dilatation of the stomach, to which patients suffering from neurasthenia are often subject, either this dilatation preceding the nervous phenomena or being their consequence. They suffer alternatively from want of appetite or bulimy; they fall off, are continually constipated, and this constipation is often accompanied by an enteria of the mucous membrane.

We have recently had the occasion of treating a certain number of these diseases, and we have systematically submitted them to the electric bath, by localizing the maximum of force of the electric current on the abdominal region by means of a disc ad hoc. The improvements obtained have been most remarkable and rapid. The appetite, in particular, becomes more regular, the patient regains weight and his general state of health improves considerably. Our space being restricted, we cannot give here our observations, but we intended to state briefly the efficiency of alternative currents, of which our colleagues, possessing the installation for hydro-electric applications, may convince themselves in cases analogous to those we have observed.

## Hot-Air and Electric-Light Baths for Medical Use.

By G. GAUTIER, M.D., and J. LARAT, M.D., of Paris, France.

Treatments by therapeutics, and by hot air in particular, are considered, since about half a century, powerful modicators of the suffering organism and the "Traité de l'Incubation," published by Doctor Guyot, in 1840, must be considered a conscientious study, full of interesting facts. Doctor J. Guyot invented many apparatuses for incubation, chiefly for wounds, amputations, diseases of the nose, besides "caisses incubatrices" for internal treatment. In these boxes the body is placed up to the arm-pits. His researches while in the service of Magendie, Robert, Breschet, Bonnet, etc., are instructive, and teach us everything that may be expected and hoped from applying his proceedings.

This therapeutics, always abandoned, has been taken up again ; it has specially been modified.

Some have recommended incubation by hot water, others by the sun. But electric-light and hot-air baths have given us an indisputable advantage and a certain effect of great superiority, allowing us to trace a new way of applications. With compressed air, saturated on its way by medicamental elements, we have acquired a new power, easily to be employed, localized and heated, allowing us to create a new proceeding and to enlarge the field of experimentation.

The mixture of these elements, electricity and air, has therefore enabled us to try, on a new basis, the therapeutic value of heat and light.

Among the diseases closely related to gout, and justifying this treatment, according to Doctor Goolden, we may mention Bright's disease, psoriasis and eczema. Hot-air baths were chiefly recommended for dyspepsia by Sir B. Brodie and Sir Erasmus Wilson, who observed, as its chief effect, the maintenance of the equilibrium of the nutritive functions which constitute health. Professor Kniger stated that this treatment was very efficacious in chronic catarrh, in the case of bronchial and emphysematical asthma, and that it prevented any tendency to taking cold. By hot-air baths the voice regains its natural clearness.

Doctor Jennings, as well as Dr. Brereton, use it even for tuberculosis in its beginning. Quite recently the local effect of hot air for treating tuberculosis has been recommended.

We had ourselves to treat several cases of sub-acute nephritis due to infection or long intoxication, and with several patients we obtained rapid results. Such an experiment demands necessarily many years' experience, for Bright's disease passes by different degrees, the etiology of which explains the reason of their existence, and in order to know the influence of hot air and light on each definite form, a group of investigators would be useful. Mr. Dehia has equally recommended hot-air baths in treating dropsies of the kidneys, of the heart and liver, as well as in chloro-anæmia and rheumatic affections. By these researches a Russian gynecologist, Mr. Thomas, of Odessa, has acknowledged by quite recent experiments that this proceeding produced excellent results on chronic uterine and peri-uterine phlegmasias. He would have obtained in a series of salpingo-ovarian cases, periuterine exudates, chronic metritis and endometritis, a rapid diminution of the pains as well as of the effusion, and a very distinct amelioration of the general state of health.

Our first experiments with hot-air and electric-light baths date from 1895, and from the beginning we have treated by therapeutics numerous cases of gynecological troubles, some by the circulation of hot air, the operative proceeding of which we have described in Dayail's thesis ; others by hydro-electric baths with alternating wave (chiefly for fibrous tumors) ; finally, a rather more restricted number of cases by heat and light. The two latter proceedings seem to us quicker in their result ; they stimulate and regulate the circulation, moderate the haemorrhages, soothe and improve certainly the general state of health.

The treatment of fibromas by hydro-electricity, seems to us, among others, a choice treatment, avoiding all local application and indicated every time that an operation is irrational or deferred.

In the *Medical Times* Doctor Libley tells us that a young girl, having been attacked by acute rheumatism, which left her an ankylosis of the right knee and two articulations of the elbow, was radically cured by hot air.

Two American surgeons, Doctors Kirby and O'Mally, have tried

hot and dry-air baths in about thirty cases of different fractures, as soon as the latter seem sufficiently consolidated to admit the taking away of the immobilization apparatus. These gentlemen have seen the oedema and tumefaction quickly recede and the function of the member becomes re-established in much less time than would be the case either by massage or electricity. The same statement has been made with persons suffering from dislocations.

As these facts are well known and the advantage of aerotherapy is indisputable, we ask us by which proceedings dry and hot air might be produced?

The most efficacious, without any danger at the same time, is electricity. The spirit lamp, or gas, burning in the heat-chests, spread odours, demand a draught which produces cold and so effect steam injurious for the treatment.

With electricity the function is perfect. Under the seat of the patient, in a box, a rheostat is fixed. It is composed of spirals, the total amount of which consume 400 watts, under 110 volts, on an alternating circuit. The lamps placed under the reflector, which is fastened to the movable lid, consume 180 watts under 110 volts, on a continued circuit.

A rheostat is put under the foot of the patient, whose head emerges from the box when the lid is turned up. Such are the different sources of heat and light. Their association constitutes a new and very important application, which will be the object of a serious study.

During the session, which may last from 20 to 45 minutes, it will be good to put cold-water compresses on the patient's head. We have replaced these compresses by the circulation of compressed air, which is cold, and the more the circulation is quickened the colder the air is getting. Thanks to the electric and compressed air canalisation, we have established a therapeutic method which is at the same time clean, useful and without danger: firstly, hot and dry air, the temperature of which is measured by a special thermometer, and then light, which, being restricted to such a small space, provides a very powerful light bath.

In another form of apparatus, the electric light bath is produced by manœuvring lenses. The luminous source springs from an arc light on a continued circuit.

The luminous rays produced by the circuits of continued and alternating currents are of quite a different disposition. We do know whether this fact has been made known, but it is important to those who are interested in photo-therapy to know that the light coming forth from the alternating arc, produces on a screen, if projected by a lens, an absolutely violet luminous disc, whilst the luminous disc proceeding from the continued circuit, by the intermediary of the arc, is more like the solar spectrum, with deep red, yellow and orange rays.

This difference of origin and these different rays have special physiological peculiarities: some of them influence chemically the living cell, the others only have a mechanical effect on its structure and its relations to one another.

The effects consecutive to the application of violet rays are known since Roentgen's discovery, and Mr. M. C. Flammarion has shown by his scientific researches the usefulness of red rays and those derived from them, chiefly for the vegetal cell.

## The Electric Arc Bath—A Preliminary Report.

By MARGARET A. CLEAVES, M.D., New York, N.Y.

The necessity of the human body for light and air is of such universal recognition that it seems quite unnecessary to refer to it here. Human beings become bloodless and colorless when deprived of sunshine, and an impoverishment of the blood with a diminution of the red corpuscles and the haemoglobin ensues. With it all there is a loss of nerve force and the establishment of profound anaemic conditions.

The value of sun baths has been recognized and practiced for ages past both in a desultory and systematic way, and their value is too well established to need comment. In the electric arc bath there is to be had the most perfect approach to sunlight in existence. The results obtained clinically may be attributed to light, heat, and ozone; to, in a word, radiant energy; but the combined activities at work are similar to those of sunlight.

It is impossible to supply sunlight to the inhabitants of large cities in proportion to their needs, but by the use of the electric arc bath this lack can be at least partially combated.

The heat of an arc light is the greatest heat known, and its active horse-power energy is greater than that of the effective sun's rays at the surface of the earth. The surface of the sun radiates 10,000 horse-power per square foot of its surface; the earth receives only one-third horse-power per square foot, of which about one-third is absorbed in the atmosphere, leaving about 0.25 horse-power received at the surface of the earth.\* A good electric arc requires an expenditure of 0.6 horse-power. The brightest part of the arc is a small area within the crater of the positive carbon.

The temperature of this brightest part is 6,300 degrees F., and the area of its brightest spot is 0.1 inch square; a stronger current does not make this spot brighter or hotter, it merely makes it larger, and this is the place which radiates most of the energy and is comparable with the sun for brightness. An arc having a crater

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\* Professor Dolbear.

of one square foot in area would radiate 8,640 horse-power—which is nearly the observed amount from the sun ; if the crater is taken to be a trifle smaller than 0.1 inch square, say one-twelfth of an inch square, then the resulting figure per square foot would be 12,441 horse power, which is in excess of the sun's rate.

During the activity of an arc ozone is constantly produced in greater or less quantities, according to the source of the E. M. F., whether continuous or alternating.

With the alternating current a greater quantity of ozone is generated than with a continuous current arc.

The arc is to be preferred as a therapeutic measure to the incandescent lamp, because of the generation of ozone, and also because it gives a spectrum containing in greater quantities all the numerous rays from the deepest red to ultra violet.

The healthfulness of the air, especially in the mountains or at the seashore, is due to the great proportion of ozone present.

Ozone has been made the subject of extensive scientific research, and the literature of the subject is both interesting and exhaustive. The scope of this paper does not permit, however, even a brief resume of the data thus obtained. It is quite enough here to briefly call attention to the following facts :

Ozone is oxidized in destroying all substances with which it comes in contact ; it is very little soluble in water, coagulates albuminoid materials and is almost completely insoluble in this coagulum. The experiments of Messieurs Labbe et Oudin go to prove that ozone has an action upon microbes when they are in distilled water, for example, but when in a solid culture medium they are protected by the surrounding substance.\*

Ozone is dissolved with difficulty in the gelatine water, and that which is dissolved is destroyed in oxidizing the culture medium, thus forming a barrier to its passage into the mass and protecting the subjacent organisms. This, they believe, is the reason for the varying opinions held as to its antiseptic properties.

The physiological action of ozone is to increase the number of red blood corpuscles, the haemoglobin and also the urea, and to establish nutritive changes. There is a difference of opinion as to whether the action of the ozone is a directly physical one or not.

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\* *Revue Internationale d'Electrotherapie*, January, 1894, p. 191.

In the experiments made by Labbe et Oudin, it was shown that fifteen days elapsed before the red corpuscles were increased.

The value of inhalations of ozone in phthisis and bronchitis, as well as in anaemia and general malnutrition, has been proven beyond question. Dr. Collard,\* at the Hospital des Anglaise, noted a marked improvement in the condition of tubercular patients submitted to inhalations of ozone, who were not attacked by hectic fever or purulent auto-infection. Messieurs Labbe et Oudin, as well as others, have obtained the same results. In inhalations of pure ozone from apparatus designed for that purpose an irritation is very apt to be set up within the bronchi, giving rise to an irritative cough which is sometimes prolonged for hours, and which will, while it lasts, unfavorably influence the appetite and digestion. When administered in too concentrated a form a certain exhaustion supervenes, which has been compared by experimenters to that of a person under the influence of chloroform after an operation. The untoward results, which have been noted from the use of inhalations of pure ozone, *i.e.*, haemoptysis, irritation of bronchial mucous membranes and diminution of appetite have not obtained from the action of ozone as generated by the electric arc or from the convective discharge of an influence machine when diffused in the air of the room, but only when administered in a concentrated form.

Light, objectively, and heat as well, consist of to and fro vibrations of the universal ether, and these vibrations are now universally believed to be of an electro-magnetic nature in their mechanism; that is to say, that the vibrational activity in the ether is both electric and magnetic. It may be that in addition to the other influences at work, there is an action due to this electro-magnetic field.<sup>†</sup>

There is no doubt but that in man, as well as in plants (evidenced by numerous experiments made upon growing plants), there is obtained an action upon protoplasmic activity by exposure to electric light. Numerous experiments have been made by M. D'Arsonval, Klebs-Loeffler, P. A. Khmelevsky, of St. Petersburg, Theodore Geisler, Dr. H. Marshall Ward, of London,

\* *Revue Internationale d'Electrotherapie*, November, 1893.

† "Electricity in Electro-therapeutics"—Houston and Kennelly.

and others, which show that sunlight<sup>4</sup> and electric light have an action upon various bacterial growths. It has been satisfactorily demonstrated in all of these experiments that the inhibitory influence upon the growth of microbes has been from the actinic or chemic rays, and that there is no action whatever in the infra red, orange, or yellow region.

Exposure to an electric arc, if exceptionally long, is followed by a condition similar in every respect to that of sunstroke, which has been characterized as an electric sunstroke.

Lavrand\* reports the case of an engineer who remained exposed for about an hour at a distance of about three feet to the rays given out by two connected arcs under a current of fifteen amperes. His situation is described as being in that part of the cone of rays where the light was least but the chemical activity the greatest.

Three hours afterward he felt a tingling in his eyes and soon presented all the symptoms of sunstroke, lachrymation, redness of the skin of the face and tingling, and then very severe supra-orbital neuralgia.

The blistering of the skin in the cases treated by the electric arc, as reported by Kozlovski, and also the sunburn following exposure to its influence are due to the actinic and chemic rays, and not to the heat.

For some time it has been regarded as possible to use electric light under such conditions as to make it fairly comparable to sunlight in its power of promoting protoplasmic activity in plants, and the clinical work done thus far substantiates the same for human beings. Whether the form of cabinet used for the electric arc bath is best for the purpose remains to be seen.

The cabinet used by the writer is 6 feet long, 2½ feet wide and 7 feet high, built in the corner of one of the office rooms. It is entirely closed in, save for an observation window, which can also be utilized for the admission of fresh air if desired, and is lined with zinc throughout, in order to prevent any danger of fire from a fragment of burning carbon. Both ends are fitted up with glass compartments, in which are suspended the arc lamps, two in number. These compartments are so arranged that the doors may either be

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\* *Journal des Sciences Medicale de Lille*, May 21st, 1898. *Presse Medicale*, June, 1898.

closed or opened. In the latter instance the ozone would be eliminated from the bath. As a matter of fact, they have been used thus far with the doors swung open. The cabinet contains an ordinary wire mattress cot, which is made up as a bed, and upon which the patient reclines. At the New York Electro-Therapeutic Clinic the lamps are on the Thomson-Houston alternating current mains of 104 volts, and each lamp takes nine amperes at 48 volts, the remaining 8 volts being consumed in the rheostat.

In the writer's office the current is taken from the Edison incandescent mains of 120 volts, and each lamp takes about ten amperes at 50 volts, the remainder being consumed in the rheostat.

Each lamp is provided with a reflector, in order, if indicated by the physiological condition, that the light may be focused on a given part of the body.

It is best that the zinc lining should be painted white, in order to facilitate the reflection of light, and as the patient lies at rest in the bath, he is bathed in a sea of light equivalent to about 4,000 candle power.

The patient is preferably nude, although the applications are sometimes made with only a partial undressing. The eyes are protected by means of colored glasses, and, if desired, the hands may be protected also to avoid any chance of sunburn.

All patients, but especially phthisical and bronchial patients, are directed to breathe in fully and deeply while lying in the bath.

When the same uniform results are secured in a greater number of cases, an effort will be made to rearrange the methods of using and to eliminate certain factors in order to reach more accurate conclusions as to the exact relation between cause and effect.

No definite conclusion has been reached by the writer as to the specific influence at work to produce the changes which have been observed clinically; that ozone plays a large and important part does not, however, admit of question. The influence of a dry climate is also too well known to admit of discussion, and the benefits obtained by a residence in Colorado are believed to be largely due to the dryness of the atmosphere discouraging the growth of bacilli, as well as to the influence of the high altitude in increasing the blood supply to the lungs and improving nutrition.

Experiments have been made showing that an exposure of the

*bacillus tuberculosis* to the action of the solar rays results either in their destruction or diminished vitality. Light is also opposed to their development.

In an electric arc bath there is an expenditure of energy similar in physical character to an expenditure of energy of the solar rays. It would almost seem that the action which takes place as the result of this expenditure must be a directly oxidizing one; for with the beginning of treatment, even from the first bath, there is a diminution of cough and expectoration.

Nutritive changes manifest themselves later, and may result directly from a stimulus to the pulmonary surface with an increased blood supply to the lungs; or later, from an increase of red blood corpuscles and haemoglobin in the general circulation.

Patients uniformly present an appearance of being rested and refreshed when subjected to the influence of the electric arc bath. By its use circulatory changes are established with a uniform regulation of the heart's action as shown by improved volume and slower rate of pulse; temperature is temporarily augmented; activity of the skin increased; respiration notably improved, fuller and slower, with gradually increasing respiratory capacity; irritability of bronchial mucous membrane promptly lessened, as evidenced by diminution of cough and expectoration.

The stimulus imparted results in a more active dissimilation as evidenced by increased urea and CO<sub>2</sub> elimination, but is balanced by an equal assimilation, shown by improved nutrition and function.

In an analysis of the cases submitted with this paper it is noted that the establishment of the nutritional change is most marked at about the end of the second week of treatment; which, so far as the action of ozone is concerned, confirms the observation of Labbe, i.e., that the increase of red blood corpuscles and haemoglobin is established about the fifteenth day.

In diseases of the respiratory system there has been noted, however, a marked effect from the administration of the first bath upon the cough and expectoration; i.e., a diminution in both. No drugs were given in any of the cases reported save as mentioned.

After improvement had been established in several cases of phthisis by the action of the electric arc, independent of all other

means, the treatment was supplemented by the use of the Franklin current, positive insulation, convective discharge with the crown electrode for from ten to fifteen minutes and with the brush electrode to the entire general surface (nutritional), localized to the chest walls, front and back (Jungs). The principle involved is the same as in the administration of a cold douche after a hot bath; i.e., to stimulate the electro-motive forces of the relaxed skin, or tone it up. It is not known that the ultimate results have been bettered by the use of the convective discharge; but, as a prolonged exposure to the influence of the arc, may be followed by undue relaxation, this has seemed the wisest course to pursue.

The electric arc is being used to some extent in Europe, and was introduced first into France by Imbert de Latouche\*, of Lyons, who constructed an arc light cabinet upon the same principle and upon the description furnished him by the writer.

Recently Kozlovskit, in *Vrach*, has published an account of the treatment of rheumatism and neuralgia by means of exposure to the electric arc. He was induced to make some observations by the statement of Ewald (medical officer to some large iron works), who had noticed that with the introduction of electric welding there had been a notable diminution in the number of cases of rheumatism, neuralgia, migraine, and other nervous diseases among the workmen. He attributed it to the beneficial effects of the electric light. Kozlovski at once, in order to bring the electric arc as a therapeutic agent within the reach of his ordinary patients, fitted up his consulting-room with a suitable plant and began making his observations. His practice was to place the patient  $1\frac{1}{2}$  meters from the light, to protect the eyes with blue spectacles, and also to use a screen of cardboard through which an aperture was cut so as to allow the light to flow upon the affected region of the body. The exposure was from three-quarters to two minutes. The patient feels a slight sensation of heat, though the temperature is never raised more than four degrees F., where the light falls on the skin. Nothing more is felt until six or eight hours afterward when itching and tingling is felt and the skin is reddened. Some forty-eight hours later desquamation occurs,

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\* *Revue Internationale d'Electrotherapie*, April and May, 1896.

† *Journal of the American Medical Association*, July 2nd, 1896.

which lasts for two or three days. In the course of three months Kozlovski treated thirty-eight patients from thirteen to seventy years of age. There were eight cases of sciatica, all of which recovered ; four of neuritis, locality not stated, two of which recovered ; eighteen of chronic rheumatism, fourteen of which recovered ; three of lumbago, all of which recovered ; three of occipital neuralgia, of which two recovered ; and two of trigeminal neuralgia, one of which was greatly benefited. In most cases three or four sittings produced an amelioration of the pain.

They were continued at intervals of three or four days, according to the amount of cutaneous irritation, but the total number of sittings never exceeded a dozen.

M. Below,\* in a recent paper read before the Medical Society of Berlin, reports 122 patients treated by means of arc and incandescent-light baths with sixty-seven cures, thirty-six improvements, and nineteen without results. The best of results were obtained in lupus, ulcers of the legs, muscular rheumatism and syphilis, while in vascular nævi, pruritus of scrotum and glans, cancer, sarcoma, alopecia, atrophy of optic nerve and cataract no results were obtained. He attributed the action in syphilis to the profuse perspiration induced, and referred to the habit of natives with syphilis, in Hayti and on the Coast of Mexico, of covering themselves with sand on the sea beach and exposure to the sunlight while they drank quantities of tea to stimulate perspiration, as exercising a similar influence. In this idea he was not supported by his confreres, and such curative action as resulted was attributed by them to the heat of the sun's rays, not to perspiration.

M. Below found that a temperature of from 75 degrees to 167 degrees F. is tolerated without disturbance of any sort, where alarming phenomena present themselves from the use of other methods, and concludes that it is a desirable means of inducing activity of the skin where, because of asthma or cardiac lesions, the usual methods are contraindicated.

The electric arc has been used by the writer in the treatment of anæmia, chorea, eczema and psoriasis with general malnutrition, but the most extended observations have been made in diseases of

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\* *Revue Internationale d'Electrotherapie*, March, April, May, 1898, p. 270.

the respiratory tract; *i.e.*, sub-acute bronchitis, bronchial asthma, acute and chronic phthisis.

The cases reported are from the writer's case-book, and also from the records of the New York Electro-Therapeutic Clinic.

The equipment of both office and clinic is of so varied a nature that other means of treatment have usually been selected for the average case, and therefore the electric arc has not been utilized to a great extent, save in respiratory troubles. Much interest has been aroused by its use in this class of cases.

Very many subjects of phthisis find it impossible to leave their homes, their families need them, and as one patient put it: "To be sent from home is to be deprived of hope and condemned to despair," therefore everything that offers a chance of improvement without climatic change should be tried.

The writer has no thought that in the electric arc a panacea for this trouble is to be found. Far from it, but the uniform results obtained in the series of cases reported suggest its probable value in curative cases. Much more extended observations will be made during the coming year and the evidence secured, subjective and objective, must speak for itself.

While in an electric arc bath there is light, ozone and a dry, hot atmosphere, like that of a midsummer's day, the writer would reiterate that she offers no opinion as to the relation between cause and effect. That is reserved for further study and investigation in which the physicist must aid the physician.

Case 1.—E. M., male, aged 28, married, carpenter. January 23rd, 1897. Acute phthisis.

Patient presented himself because of cough with pain in chest, following a malarial attack last summer. Now has constant cough muco-purulent expectoration, night sweats, cachexia.

#### Physical examination.—

Inspection: Skin pale and white, emaciated, clavicle and ribs conspicuous, retraction of chest walls with impairment of motion in infra-clavicular spaces, heart beat in normal position accelerated.

Palpation: Vocal fremitus increased at right apex.

Percussion: Marked dulness over right apex, extending to fifth interspace.

Auscultation: Broncho-vesicular breathing, sibilant and sub-

crepitant rales over right apex ; increase of vocal sounds ; on left side very harsh inspiration and broncho-vesicular expiration. Pulse, 100 ; temperature, 100.2 ; weight, 121 $\frac{1}{2}$  lbs.

Treatment : Electric arc bath, exposure from twenty to thirty minutes ; temperature of bath, 90 degrees F. Five treatments given, extending over a period of two weeks. At second visit, "more life and energy, and felt like getting around," before "felt like sitting about." Appetite better ; cough diminished. At time of third visit further diminution in cough, sputum less purulent. At fourth visit cough much diminished, strength increased, sense of well-being.

Improvement maintained, no night sweats while under care, save night following first treatment, improved color, gain in weight 2 $\frac{1}{2}$  lbs. The patient through whom he came to the clinic reported two weeks later continued improvement, and that he had gone to work again. Subsequent history not known. Two specimens of sputum were secured and examined, but the *bacillus tuberculosis* was not found. Examination not regarded as conclusive.

Case 2.—J. B., male, aged 40, married, plate printer. December 28th, 1897. Chronic phthisis.

Has worked in a plating factory (bronze) for eight years. Onset sudden ; began to cough and expectorate muco-purulent matter November 1st, 1891. Condition has persisted for past six years ; morning cough and almost daily expectoration. For past seven months dyspnoea on exertion ; evening temperature. Under medical care for five years ; thinks he is no worse than one year ago, save increased dyspnoea. Has had three tubercular ulcers (laryngeal) ; two disappeared under treatment ; third remains. No history of consumption in the family.

#### Physical examination.—

Inspection : Emaciated ; waxen skin ; marked dyspnoea ; incessant cough ; impairment of motion in infra-clavicular spaces ; clavicles conspicuous ; heart beat accelerated ; respirations more frequent than normal.

Palpation : Skin warm and dry ; increased vocal fremitus both upper lobes, especially right.

Percussion : Marked dullness upper lobe right, less marked on

Auscultation : Increased vocal fremitus both upper lobes ; cavernous breathing on right ; subcrepitant rales right lower lobe posteriorly ; friction rale on left low down.

Examination of sputum : *bacillus tuberculosis* found.

Treatment : Electric arc bath, exposure 35 minutes, temperature 90 degrees F.

Twenty treatments given, extending over a period of seven and one-half weeks. At first visit incessant cough from time of entering clinic room up to going into bath. Just before conclusion of bath marked moisture of palms, hands and forehead observed.

Sensation of bath pleasant ; coughed but once during its continuance, and not but once for twenty-five minutes afterwards. Two days later, at second visit, stated that he had coughed less since treatment than during the same time for two months previous.

At conclusion of second treatment hands and forehead moist as before ; no cough ; freer and easier respiration during bath.

At third visit reported less dyspnea. At fourth visit, January 6th, 1898, no cough night of previous treatment, January 4th ; once night of 5th ; not at all during day of 6th. Rate of respiration diminished from 40 before first treatment to 30. At fifth visit, eleven days after coming under care dyspnoea diminished ; able to walk several blocks without getting out of breath. Expectoration of a saltish taste, instead of sweetish as before, more nearly normal in color ; contained less purulent matter.

At sixth visit, two weeks from beginning of treatment, had an irritative cough with discharge from posterior nares. Walked ten blocks two days previously ; dyspnoea slight ; expectoration decreased ; color of skin improved ; sleeping better ; no cough while at clinic—one and a half hours ; laryngeal ulcer healed ; throat much less anaemic. Throat examined January 10th, at Throat Clinic, New York Polyclinic ; healing of ulcer also noted.

At first six visits the electric arc bath alone was used.

Beginning on the seventh and for the remaining fourteen treatments it was followed by Franklin current, positive insulation, convective discharge with crown electrode ten minutes, and with brush electrode to entire general surface (nutritional), localized to chest walls, front and back (lungs), five minutes.

During seventh bath no cough. Three and one-half weeks after coming under care increased strength; brighter facies; better color; eyes not so preternaturally bright.

Improvement continued, characterized by diminished cough, expectoration, improved appetite and sleep. On January 18th, nasal and throat examination revealed hypertrophic rhinitis and pharyngitis. For this two applications of intranasal cupric electrolysis were made at intervals of nine days. About the first of February for a day or two appetite not good; cough slightly increased. Sputum examined on admission to clinic, two weeks later and again at end of four weeks; *bacillus tuberculosis* found in every instance; fewer in the field at last examination.

At no time while under treatment did patient have special nursing and exceptionally sufficiently nourishing food. This was especially true during the month of February. February 22nd, admission was obtained to St. Luke's Hospital, in order that he might have care and nutritious food during the trying weather of the spring months. For the first eleven days gained five pounds, which he lost in the next ten days. Three weeks after entering hospital complained of sore throat. Examination revealed two tubercular ulcers on laryngeal cartilages. In the hospital until April 1st; unable to swallow food; discharged April 1st, 1898. Returned to clinic April 7th, 1898. Emaciated; extreme pallor; dyspnoea and exhaustion. No physical examination made because of the patient's great exhaustion, but the following treatment was given; Franklin current, positive insulation, convective discharge, chain in hands, with crown electrode fifteen minutes, and with brush electrode to the entire general surface (nutritional), localized to the chest walls, front and back (lungs), and over laryngeal region (ulcers), ten minutes.

Patient felt brighter and stronger after treatment, dyspnoea lessened, improved circulation, return of color to face, able to get down stairs more comfortably. The query naturally rises, might not the improvement established have maintained itself if the patient could have had continued treatment while in the hospital where food and care were provided? It is impossible to answer the question now, but it seems reasonable to believe that under proper conditions the continuance of the treatment would have

led to better and more permanent results. This patient was living a month since (about August 7th), and up and about. Owing to change of residence cannot ascertain his condition at this writing. For several years he had been given creosote, which was not discontinued when he came under care, on account of his desperate condition. The relief obtained, however, was coincident with the establishment of his treatment by means of the electric arc bath and progressive under its use.

Case 3—B. B., female, aged 35, single, seamstress. January 4th, 1898. Acute phthisis.

Patient had la grippe five or six years ago. Pleurisy four years ago, and since then when she takes cold suffers pain in breathing, left side. In May, 1897, contracted a severe cold; tired; pains all over body; knees, ankles, and hands stiff; in hospital eight days; improved. Has not been fully well since; now pain and stiffness in shoulders, arms, fingers, and feet; badly nourished; constipated. For malnutrition and rheumatism the following treatment was given:

Franklin current, negative insulation, disruptive discharge, sparks long, clean, and percussive to entire general surface (nutritional), localized to affected joints (pain and disability), and to lumbar and sacral plexuses, hepatic area and abdominal walls (constipation). Eighteen treatments were given extending over a period of four months establishing marked nutritional gain with great relief from pain, stiffness and constipation.

Patient discontinued regular attendance April 2nd, 1898.

On April 16th, 1898, returned complaining of sore feeling through chest, with muco-purulent expectoration. Usual treatment given, but could not remain for physical examination. May 3rd, 1898. Physical examination: congestion of right lower lobe, difficult breathing; hard dry cough, scant expectoration. Treatment: Electric arc bath; exposure thirty minutes; temperature of bath 90 degrees F. Nine treatments given, covering a period of five weeks. Following first treatment respiration freer and easier; appearance brighter. May 5th, sputum examined, *bacillus tuberculosis* found. At second visit looked much brighter, less worn, no sense of oppression in breathing since last treatment, cough looser. Physical examination made at

time of fourth treatment showed sibilant and sonorous rales, and elicited the fact of moderate expectoration. After fifth treatment patient felt stronger ; coughed less. Continued improvement characterized by increased strength ; more energy ; diminished cough and expectoration, freer respiration. Clinic closed June 11th, for summer holiday, therefore further treatment could not be given. Arrangements were made to send patient to the country under the auspices of an association for the relief of work-girls, the subjects of tubercular troubles. Over fatigue and exposure to night air incident upon her going for the necessary physical examination by the physician of the association brought on an exacerbation of her trouble, and she did not leave the city until July 30th. On August 16th, reported by letter from Franklin Co., New York, that she had gained three pounds and was much better. Case to be followed up.

Case 4.—M. E. L., married. Acute Phthisis. Came for consultation March 31st, 1898. Family history good ; no consumption ; patient had systematically overworked in the active care of a large business concern ; general health poor for several years ; less well for a year past.

In the spring of 1897 began to cough, lost strength and flesh. In the same summer took a sea voyage and was absent from his business several weeks. Nutrition improved and cough diminished during this time; but soon after his return took cold, cough returned, with loss of flesh and strength and increasing nerve irritability. In September he was seen by his physician and examined also by Dr. Delafield. Trouble was found at the apex of the right lung and bacilli in the sputum. Dr. Delafield told him he must give up his business and go elsewhere in order that he might be under suitable climatic conditions. The patient was very much averse to this, and decided that rather than give up his business interests and go away he would work as long as he could in order that he might provide in the best possible manner for his family and accept the inevitable when it came.

He did nothing during the winter and early spring, save to take cod liver oil and hypophosphites. At the time he came under care, March 31st, 1898, he was a good deal worn ; nervously irritable ; had lost and was still losing flesh ; coughed a good deal, especially

in the morning and at night ; wakened by cough between four and five in the morning ; expectoration muco-purulent ; appetite poor and sleep broken.

Physical examination.—

Inspection : patient fairly well nourished. Clavicles and ribs somewhat conspicuous

Palpation : no change in tactile fremitus.

Percussion : slight dulness over upper lobe on right, front and back. Note normal on left front and back.

Auscultation : subcrepitant rales above and below clavicle on right over area of upper lobe. Voice and breathing slightly bronchial ; increased vocal fremitus.

Examination of sputum : *bacillus tuberculosis* found.

In answer to his question as to whether anything could be done for him ; the remedial value of sunshine, whether natural or artificial, and the function of electricity to improve and to restore nutrition were briefly outlined, and the improvement of several cases of phthisis under the influence of the electric arc bath detailed.

He decided to place himself under care, and treatment was instituted on the same day. For the first fourteen days treatments were given daily, with the exception of the intervening Sundays.

Treatment consisted of the electric arc bath. Temperature of bath 90 degrees F., exposure varying from 30 minutes to 1 hour. There was an immediate diminution of the cough, with gradually diminishing expectoration. Improved appetite and sleep, and marked lessening of nerve irritability. At the end of the first week of treatment the patient had gained three pounds ; cough was markedly diminished ; sleep and appetite improved. Improvement continued, and two weeks from the day he came under care physical examination was negative, save for a slight increase of vocal resonance at the apex of the right lung. In an examination of the sputum two weeks and three days from the time of instituting treatment, no bacilli were found. The gain at that time in weight was five pounds. Throughout the rest of April and during May almost daily treatments were given, Sundays excepted, and an occasional week day. In one instance only was there an exposure of an hour, and that at the request of the patient, to whom the

bath was most grateful ; but it was followed by unusually profuse perspiration, with slight exhaustion. After that time fifty minutes was not exceeded, while the average time was forty-five minutes.

During the month of June and the first week in July an average of from three to four treatments a week were given. At the beginning of the fourth week he was directed to secure a third specimen of sputum for examination ; but at no time, either in the night or morning, was he able to secure anything, though he carried a bottle in his pocket for this purpose for the following two weeks.

There was absolutely no cough nor expectoration. Improvement in appetite and sleep continued, with a further increase in weight. Nervous irritability disappeared entirely, and the patient experienced a sense of general well-being.

During the month of June his business necessitated his going into a new building which had not fully dried out, and as a result he developed malarial symptoms. He had at different times in his life suffered from chronic malaria. At that time he was given an antiperiodic, which was the first and only medicine given him while under treatment. Cod liver oil was not used, but as much cream was taken as he could digest.

In all sixty-six treatments were given, extending over a period of three months and ten days. In the second week of his treatment the electric arc bath was omitted for three or four days, owing to an accident to one of the lamps which was not promptly repaired.

Following the arc light bath, the following was given :

Franklin current, positive insulation, convective discharge with the crown electrode 15 minutes, and with brush electrode to the entire general surface (nutritional), localized to chest walls, front and back (lungs).

With the establishment of nutritional changes, some three weeks after coming under care, the disruptive discharge was used and the application made to the entire general surface. At the same time a hypertrophic rhinitis with hypertrophy of the posterior turbinated bodies was treated with cupric electrolysis.

The applications were made with a thin copper electrode having

concavo-convex surfaces, by means of which an accurate localization of the oxychloride of copper was made directly over the turbinated bodies. Before instituting nasal treatment, there was difficulty in breathing, with profuse post-nasal dropping and constant hoarseness. These symptoms were of several years' standing. In addition to the nasal treatment, a slow interruption of the induced current, regulated to the patient's toleration, was used in percutaneous applications to the throat; i.e., from side to side for five minutes and from nape to larynx for five minutes, daily. As a result of nasal treatment, nasal respiration became absolutely free, and post-nasal dropping stopped entirely.

To date there has been no return of these symptoms. The throat became very much stronger under the use of the induced current, with gradual disappearance of the hoarseness, which returned but once while under care, when, owing to a sudden change late one afternoon, from the extreme heat prevailing, he took cold. He came to the office the following morning with an acute laryngitis, exceedingly hoarse, with almost a whispering voice. The usual treatment was given: Electric arc bath, followed by convective discharge and the application of the induced current to the throat.

He left the office at conclusion of treatment with practically a normal voice, and maintained his improvement.

His total gain in weight up to the end of the first week in July was eight pounds. He is a man of very slight build. He attended to his business every day, not losing an hour save the hour spent in the office for the purpose of treatment. A note on the 6th of July, stating his inability to keep an appointment, ends with the remark: "feeling fine." On the 9th of July, writing in reference to being away for his vacation, he stated that he was very well.

This patient has been given to understand that the maintenance of his improvement depends very largely upon himself, that every attention must be paid to all matters of hygiene, and that he must have out-door exercise and sunshine. Realizing fully the nature of tuberculosis, it follows that if at any time his nutrition falls below par, the bacilli are apt to become active and the trouble develop anew.\*

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\* November 25th, 1898. Remains well.

The positive results obtained in this case, as well as the improvement obtained in cases of much longer standing, are, to say the least, suggestive.

Case 5.—M. T., female, age 28, importer. July 9th, 1898.  
Acute phthisis.

Father died of pneumonia ; mother has chronic malaria. One brother died, at the age of six, with "brain trouble." Patient not strong, and always nervous as a child. Menstruated at age of 12, usually pain for 24 hours before flow, duration four days, amount normal. Has occupied her present position for eight or nine years, and has over-worked ; meals irregular ; for past four years much mental worry. Life indoors most of the time. Four years ago last February began to go to Paris twice a year to buy goods ; since that time less strong ; for three years tired all the time ; unable to get rested ; very nervous and has lost flesh during last two years. Last February took cold ; nose and throat first, finally lungs.

Since then has had a cough, especially on retiring and rising ; at intervals muco-purulent expectoration. Every two weeks since has had an attack of coryza, with incessant sneezing and nasal discharge ; malaise and great fatigue. At time of coming under care morning and evening cough, worse in morning, wakens her ; mucous expectoration, at times muco-purulent ; bowels constipated, micturition frequent.

July 13th, 1898, examination of sputum and *bacillus tuberculosis* found.

#### Physical examination.—

Inspection : Patient poorly nourished ; retraction of chest walls above and below clavicles, especially on right ; skin inactive, pigmented in defined areas over sternum.

Palpation : Vocal tactile fremitus normal.

Percussion : Percussion note, anteriorly and posteriorly over upper lobe of right lung, is of higher pitch and of shorter duration than normal. Note over left chest normal.

Auscultation : Vocal resonance increased over upper lobe on right subcrepitant rales below right clavicle ; diminished breathing. Left side anteriorly sounds normal ; posteriorly, infra-scapular region loud sonorous rales.

July 25, 1898.—Sputum examined and *bacillus tuberculosis* found. Treatment: Electric arc bath; exposure 20 minutes to 1 hour. The shorter exposure was given on the hottest days. Free perspiration always established, with improved color and rested appearance. At the end of the first five days cough markedly diminished both night and morning; expectoration decreased. For the first eight days, treatment given daily except on Sunday; during the two weeks following, treatment was administered daily, with one exception, while the last week but three treatments were given.

August 5th, 1898.—Physical examination: Skin of better color, less dry and harsh; respiration freer; volume increased. Subcrepitant rales; no sibilant nor sonorous rales. Percussion note improved.

Sputum examined and *bacillus tuberculosis* found.

At intervals of five days, three applications of cupric electrolysis made to hypertrophied turbinate body, inferior left, 5 milliamperes, 3 minutes each. At the end of two weeks, in spite of the heat of the summer weather and continued application, there was a gain of one pound; improved appetite and sleep; general sense of well-being; no cough at night, rarely in the morning; scarcely any expectoration, save from the throat. Menstruation established August 1st, free from pain, very comfortable. Is to sail for Europe to-morrow, August 6th, to be gone five weeks. The following was given to take during her absence as a digestive tonic:

Fl. Ext. Cascara Sagrada	-	-	dr. iv.
Dil. Nitro-Muriatic Acid	-	-	dr. iii.
Elix. Calisaya Bark	-	-	oz. iv.

M. Sig. One teaspoonful one-half hour before meals, as needed, to keep bowels open.

Also—

Arsenious Acid	-	gr. 1/60	} each.
Iron Powd.	-	gr. 1/5	

Tablets 100. Sig. One t.i.d. just after meals.

She is to return for examination the last of September, and will remain under observation.

Case 6.—J. G., male, age, 20, shipping clerk. August 19th, 1888. Father dead; mother living and well; one sister, one brother—both well. For the last two or three years not well; chronic malaria. Began to run down in April last and had a severe haemorrhage, pulmonary, at that time. Went to the country, absent until July 4th. No haemorrhage during absence. Made some gain. Since return has steadily lost flesh; troublesome cough with expectoration; sense of malaise; poor appetite. In July had a very severe haemorrhage, lost a good deal of blood, from which he has not recovered. On July 31st, consulted Dr. C. O. Maisch, Instructor in diseases of children, New York Post Graduate Medical School and Hospital, who reports the following:

"Slight dulness over left apex, anterior more marked; accentuated breathing; vocal fremitus slightly increased, no rales; right lung, over apex, a few sibilant rales; respiration over both lungs very much restricted; retraction of intercostalis and some dyspnoea always present; expectoration moderate, cough not very troublesome; haemoptysis; anorexia; malaise; weakness; emaciation progressive. Sputum contains a very few tubercle bacilli. Temperature, 100.2; pulse, 110.

"August 12.—Physical examination.—

"Over left apex, dulness to within an inch of inferior angle of scapula, and over this area there is marked increase of vocal fremitus; bronchial and tubercular breathing; crepitant and subcrepitant rales; moist mucous rales over the entire surface indicated. Right lung unaffected. General condition much worse. Temperature, 101.5; pulse, 120; cough troublesome and expectoration considerable.

"August 20.—Patient in same condition; complains a great deal of weakness."

This patient was referred to the writer for treatment, August 19th, 1898. Physical examination was not made nor treatment instituted until August 20th. At that time patient presented appearance of a very ill person; loss of flesh, great difficulty in breathing, rise of temperature, evening and morning cough most marked, occasionally during day, moderate expectoration, poor appetite, regular bowels, malaise, great weakness, and walked with difficulty even a few steps.

**Physical examination.—**

Inspection: Patient much emaciated, anaemic; chest walls retracted; left chest flattened, with impaired motion.

Palpation: Marked increase of vocal tactile fremitus over left chest anteriorly.

Percussion: Marked dulness over upper half left lung anteriorly and posteriorly.

Auscultation: Crepitant and subcrepitant rales over area of dulness on left; vocal fremitus markedly increased; harsh breathing. Right side normal.

Patient very weak and obliged to sit several times during the examination.

Treatment: Electric arc bath, exposure twenty to thirty minutes, temperature 90 degrees F.; followed by Franklin current, positive insulation, convective discharge with the crown electrode for fifteen minutes, and with brush electrode to entire general surface (nutritional), localized to chest walls, front and back (lungs), for five minutes. Afterwards sat upon the platform for five to ten minutes daily, with ground connection removed and discharging rods within sparkling distance of one another. During this time directed to breathe deeply and steadily of the ozonized atmosphere.

Daily treatments given up to August 27th, excepting the intervening Sunday and, save in two instances, the exposure lasted for one half hour. From the beginning of treatment there was a marked lessening of dyspnea, increasing respiratory capacity, slight diminution in cough, with, as a rule, less expectoration.

On August 25th appeared very much better; facies brighter; respiration freer; coughing only in the morning, and less than before; taking sufficient food, but without special appetite; lowered temperature and diminished pulse rate; able to walk five or six blocks without much effort. On the 26th and 27th had rather a sharp attack of diarrhea which caused considerable weakness. From August 19th the weather was excessively hot with great humidity, and as patient's home was a single room in a tenement house in the most crowded portion of the city, he was unable to get much rest at night.

On August 27th referred back to Dr. Maisch for examination

with the following result: Temperature, 99; pulse, 115; general condition of patient improved; dyspnoea less troublesome (very much); coughs less. Lungs: Left apex, dull as before, has not extended; rhonchi seemed fewer in number and would indicate that liquefaction was not so great as at last examination. Right lung not affected. Moderate diarrhoea. To patient, physician stated, "You are very much better." Treatment August 29th as before. Slight diarrhoea; coughing but little and in morning only; raising less than before.

In answer to an inquiry as to why the patient did not return for treatment the following letter is quoted:

" 223-225 E. 17th St., N. Y. City,  
" Sept. 7th, 1898.

" DEAR DR. CLEAVES,—Yours of the second inst. in reference to J. G. received. I had heard nothing of him and so looked him up yesterday at his home in Baxter Street. He has been in bed some days. I found him with temperature 104 degrees, pulse 120, and in pretty bad condition. He has an acute pleurisy on the left side anteriorly. The physical signs in the chest have not changed since I saw him, except that he has developed a diffuse bronchitis involving both sides. His general condition is worse; his surroundings are bad and the hygienic conditions hopeless. He has had no haemorrhage. Should he get up again he will come to you.

" Yours, C. O. M."

Case 7.—A. M., female, age 29, single, dressmaker. February 18th, 1896. Eczema Cruris.

Presented herself because of spot on anterior surface of right leg. One year since fell and scratched her leg below the knee. Spot became red, infiltrated, itched moderately, with tendency to moisture, stocking adherent; later crusts appeared on the surface.

#### Physical examination.—

A patch size of palm of hand below patella, color dull red; covered with crusts and exuding moisture; tissues underneath thickened and swollen.

Treatment: Continuous current, active electrode six square inches in area over eczematous surface negative; indifferent electrode, right foot in normal saline solution, temperature, 100 degrees F., 5 milliamperes, 10 minutes.

Four applications were made extending over a period of ten days. After second treatment marked hyperæmia over upper part

of patch ; tissues softer with partial loss of crusts. After third treatment several islets of healthy skin visible, fewer crusts ; improved circulation. Because of general malnutrition, treatment changed from local application of the continuous current to general nutritional treatment, as follows : Electric arc bath ; exposure thirty minutes ; temperature of bath 90 degrees F.

Two treatments extending over a period of sixteen days. Not able to come for further treatment because of a severe cold contracted from exposure going to and from her work. In May reported through a friend that the patch of eczema had entirely disappeared. No drugs given. From clinical experience with other cases of eczema treated solely by the continuous current the opinion is justified that the prompt and complete disappearance of the eczematous spot was due to the action of the electric arc. The light was focused directly on the spot of eczema.

Case 8.—F. W., female, age 3. December 3rd, 1896. Subacute Bronchitis.

At age of sixteen months patient had pneumonia, at two years tonsilitis, and eight months subsequently malaria, intermittent type. Two weeks prior to admission contracted a severe cold, characterized by febrile disturbance, loud breathing, moaning in sleep, pain through chest and cough at night.

Physical examination.—

Subcrepitant rales over chest anteriorly and posteriorly ; crepitant rales in inferior clavicular region left ; sibilant rales right.

Treatment : Electric arc bath ; exposure twenty minutes ; temperature of bath 90 degrees F.

Eight treatments given covering a period of six and one-half weeks. Pulse and temperature records taken before and after treatment, showed that the pulse markedly irregular before treatment, became normal in character after the first three treatments. It was uniformly diminished in rate and of better volume. Upon leaving the bath the skin was always warm and moist and respiration freer.

At fourth visit physical examination revealed the presence of large mucous rales and the mother reported that the cough was looser. After fourth treatment patient did not cough during the night. The congestion gradually disappeared, appetite and sleep

improved, and respiration became normal. Patient always fell asleep in bath. Discharged recovered. No drugs given.

September 1st, 1898. No trouble since.

Case 9.—H. B., female, age 26, single, nurse. April 10th, 1895. Psoriasis Universalis. Referred from the New York Skin and Cancer Hospital.

Physical examination.—

General eruption over body, more marked on extensor surfaces of arms and legs; red papules covered here and there with silvery white scales; no discharge; conjunctiva and gums anæmic; depressed; case has proven an obstinate one, and has not yielded to classical treatment.

Treatment: Electric arc bath; patient nude; exposure, thirty minutes; temperature of bath, 90 degrees F. Four treatments given, extending over a period of nine days. After first bath circulation improved, skin warm and moist; patient felt warm and comfortable and looked rested.

At second visit improved appetite and sleep, with general sense of well-being. After second treatment, remarked that she "felt that she had been born again." Improvement continued, characterized by nutritional gain and clearing up of skin. Treatment suspended at end of nine days as patient had to leave the city. Subsequently heard from through an interne of the New York Skin and Cancer Hospital, who reported that she was entirely well. No drugs given. In this case, as well as every other reported, the patient always looked rested and refreshed upon leaving the bath—skin moist and rosy, eyes bright.

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#### DISCUSSION.

Dr. R. J. NUNN, of Savannah, Ga., said that he had listened with pleasure and interest to this paper, as it opened a wide albeit rather old field. He had long been of the opinion that the present generation was erring by living too clean, shutting out light and dust, and eating refined flour and drinking pure water. The paper brought up the interesting subject of the therapeutic value of sunshine, and while such treatment probably could not be practically carried out extensively in large cities, it could be elsewhere, and it

must be admitted that where it was available, sunshine is better than artificial light. Modern chemistry has shown the atmosphere to be such a complex substance that it does not seem desirable to say very much about ozone. Again, to use a military expression of the time, "It's not the gun, but the men behind the gun," by which he meant that in such work as that described in the paper, the influence of the personal equation must ever be borne in mind.

Mr. JOHN J. CARTY, E.E., of New York, said that it would seem that enough had been reported to warrant one in asking as to what there really is in the arc light to produce these results. It seemed to him that there were certain results due to radiation, and others due to the emanations from the arc. The latter would be introduced by inhalation. It should not be forgotten that the oxidation of the carbon itself is not simple. Nearly all the carbons are now covered with copper, which is burned off, and many of these carbons are composed of various organic compounds. We do not know that the good results obtained are due to light, heat or any known wave; it is not improbable that the composition of the carbon itself is responsible for some at least of the phenomena that have been observed.

Dr. FRANCIS B. BISHOP, of Washington, D.C., said that he had seen the working of Dr. Cleaves' electric light cabinet, and he had noticed that immediately upon turning on the light there was a strong odor of ozone. In Paris there had been recently adopted an interesting method for the purification of the River Seine, which gives up so many victims to the morgue every morning. It had been found that the water could be most satisfactorily purified by means of ozone. He was of the opinion that the good effects obtained with the arc light cabinet were largely due to the inhalation of the ozone. Considerable ozone was generated by the disruptive discharge in the air, or by the convective discharge from the static machine. He had been using the ozone bath for a number of years, and had obtained magnificent results in patients in the early stage of phthisis.

Dr. G. BETTON MASSEY, of Philadelphia, Pa., said that there must be an important influence exerted by the actinic qualities of the electric light and of the sunlight. Our large cities are making the mistake of shutting out the precious actinic qualities

of sunlight by roofs which do not allow of the entrance of light. Our houses should be differently built so that sunlight could gain freer admission. The effect of sunlight on the vegetable world is striking and well known. It seemed to him that the treatment might have a special value if the rays were concentrated and sent through special diseased areas of the body.

Dr. CLEAVES, in closing the discussion, said that she had no opinion to offer as to the particular property of the electric arc influencing the results, detailed in the cases reported. The presence of light, heat, a dry atmosphere and ozone admitted of no discussion. Bearing upon the generation of ozone and also upon the influences hinted at by Mr. Carty are recent experiments "on the electrical properties of the carbon arc," by Ernest Merritt and M. Stewart. In a paper read before the A.A.A.S. they point out that the phenomena observed in their experiments may be explained on the assumption that the air is "ionized" by passing through the arc; that is, the molecules of air are to some extent torn apart so as to form positive and negative ions as in electrolysis. At this moment, however, so far as the therapeutic use of the arc is concerned it suffices to simply point out the clinical results obtained. In only one of the cases of phthisis reported had there been a complete disappearance of the *tubercle bacilli*, but in all the cases there had been a uniform improvement.

## The Electric-Light Bath.

By J. H. KELLOGG, M.D., Battle Creek, Mich.

Considering the manifold uses to which the electric light has been put, and especially in view of the fact that it was early employed in photography, it is indeed surprising that its value for therapeutic purposes should have remained so long unknown, for it is scarcely half a dozen years since attention was first directed to the high value of this therapeutic agent.

From a physical standpoint, light and heat seem to be nearly, if not quite, synonymous terms. The physicist tells us that the phenomenon of light is the result of certain rhythmical disturbances of the universal ether, the pulsations of which are, in some sense, analogous to those of air which produce the phenomenon of sound. The whole gamut of these disturbances, which are recognized as heat and light, comprises, we are told, about four octaves, one only of which produces the so-called luminous waves, there being two octaves below and one above which give rise to the impression which we call heat. The skin seems to have a greater range of sensibility in this regard than the eye, a fact which we need not consider remarkable, since the eye is only a highly differentiated and specialized portion of the skin. The thermic function of the skin is, when understood, certainly as remarkable, and presents as many problems which are not easily explicable, as does the eye.

Radiant energy is converted into heat only when it meets with resistance. The skin is translucent, almost transparent, when in a thoroughly healthy condition. The rays of radiant energy which we call heat or light, passing through the skin, meet with obstruction in the deeper tissues, and are there converted into heat. Hence the therapeutic effects of the electric-light bath are practically those of heat.

The physiological effects of heat have been carefully studied by a large number of investigators, especially within the last fifty years. I myself have made many hundreds of experiments, not only with the electric-light bath, but with various other forms of

thermic application. The therapeutic effects of the application of heat by means of the electric-light bath may be summarized as follows :

*General Effects.*—1. Heat is primarily an excitant. It is, indeed, one of the most powerful of all vital excitants. It increases vital activity, elevates the temperature, excites the brain and nerve centres.

2. The secondary effect of heat is depressant, the result of atonic reaction, lowering of the temperature through reflex action, resulting in lessened heat production, and increased heat elimination, with generally diminished tissue activity.

3. Short hot applications to the surface cause dilatation of the small veins of the skin, with strong revulsive effects upon the related internal parts.

4. Prolonged hot applications give rise to mixed effects of excitation and exhaustion, either of which may predominate.

*Effects of Heat upon the Skin.*—1. Contraction of yellow elastic tissue, relaxation of white fibrous tissue.

2. Goose flesh appearance from contraction of smooth muscular fibre.

3. Reddening of the skin, or, if suddenly applied at a temperature of  $110^{\circ}$  to  $130^{\circ}$ , brief palor from strong stimulation of the vaso-constrictors, followed by reddening of the skin due to dilatation of the small veins. The dusky red appearance of the skin under the influence of heat is due to the presence of venous blood. Contraction of the vessels of the skin with pallor occurs after the heat is withdrawn, when the application has been prolonged.

4. Increased perspiratory and respiratory activity.

5. Increase of tactile sensibility at neutral and hot temperatures, decrease at temperatures of  $113^{\circ}$  and upwards.

6. Increased heat elimination from the skin (a) through dilatation of the surface vessels, (b) through increase of the flow of blood through the skin, (c) through increased evaporation of moisture from the surface, and (d) through increased conductivity of the skin.

7. Heat prepares the skin for cold applications.

*Effects of Heat upon the Circulation.*—1. A general application

of heat increases the force and frequency of the pulse, both of which diminish when free perspiration begins.

2. Very hot applications ( $104^{\circ}$  and upwards) cause slight contraction of the small vessels of the skin, soon followed by relaxation. Warm and hot applications cause dilatation of the surface vessels, especially of the small veins, producing a dusky red color, owing to the increased quantity of venous blood in the skin.

*The Effects of Heat upon Respiration.*—1. A general application of moist heat increases the rate and ease of respiration. Hot dry applications hinder respiration.

2. After the withdrawal of a very hot application there is for a time diminished rate and depth of respiration. The increased rate of lung movements following the application of heat is due to the reflex action, whereby all heat eliminative processes are quickened.

3. An external temperature above  $60^{\circ}$  or  $70^{\circ}$  F. increases CO<sub>2</sub> elimination, while a temperature below  $40^{\circ}$  F. also decidedly increases CO<sub>2</sub> elimination, in the first case by raising the temperature of the blood, in the second case by producing thermic reaction. Cold air does not increase heat production so long as the body is so protected that chilling of the surface and consequent lowering of the temperature of the blood is not produced.

*Influence of Heat upon the Muscles.*—1. Short hot applications,  $98^{\circ}$  to  $104^{\circ}$ , increase the excitability and energy of the striated, or voluntary, muscles.

2. Very hot applications ( $106^{\circ}$  to  $120^{\circ}$ ) lessen the energy and excitability of the voluntary muscles.

3. Very hot applications increase the excitability of the non-striated, or involuntary, muscles, as shown by goose-flesh appearance of the skin following a very hot application, and the contraction of the small vessels of the skin and other organs.

4. Neutral temperatures ( $92^{\circ}$  F. to  $98^{\circ}$  F.) diminish the excitability of the striated muscles, hence the relaxing effect of a neutral bath.

*Effects of Heat upon the Nervous System.*—1. Very hot baths produce various nervous disturbances, as sleeplessness, nervousness, headache, and various other symptoms of nervous excitation and exhaustion.

2. Extreme heat, as in sunstroke, may give rise to the develop-

ment of special poisons, which act upon the nerve centres of the brain and cord.

3. A short hot application powerfully excites the nerves and nerve centres.

4. The excitant effects of heat are quickly followed by depressing effects.

5. In prolonged applications of heat, excitant and depressant effects appear together, the dominant effect depending upon the temperature employed, the form and duration of the application, the temperament and condition of the patient, and other factors.

*The Influence of Heat upon the Blood.*—Hot applications, especially when followed by cold, increase the number of blood corpuscles in circulation.

*The Influence of Heat upon General Nutrition.*—Within certain limits (98° to 113° F.) heat is a powerful vital stimulant or excitant. At higher temperatures, heat lessens nerve sensibility and vital activity, and at very high temperatures the effects of heat are practically identical with those of extreme cold. The sunlight and the electric light are especially active and useful.

*The Influence of Heat upon the Functions of the Stomach, Liver, and other Abdominal Organs.*—Prolonged applications of heat over the region of the stomach in the form of fomentations, dry heat, or the hot douche, increase the amount of hydrochloric acid secreted by the stomach. Short hot applications, especially the short hot douche, diminish the secretion of HCl.

2. Prolonged applications of heat over the region of the liver stimulate the flow of bile and other liver activities. Short hot applications, especially the short hot hepatic douche, relieve congestion of the liver.

3. Prolonged applications of heat over the abdomen increase the functional activity of all the abdominal viscera.

4. Short hot applications over the kidneys and the short hot renal douche diminish renal activity.

*Effects of Hot Applications upon Heat Production and Body Temperature.*—1. General applications of heat cause immediate rise of temperature. This is true even when the temperature of the bath is no higher than that of the body itself.

2. An external temperature above 60° F. to 70° F. occasions

increase of heat production. A temperature of 104° F. increases heat production to the extent of three hundred and fifty per cent. in dogs, and to a corresponding extent in man.

3. An application of heat is followed by a fall of temperature, due to diminished heat production and increased heat elimination, the result of atonic reaction.

*The Electric-Light Bath as a Means of Inducing Perspiration.*—Bouchard has shown that an elevation of the temperature of the blood .7° F. is sufficient to induce general sensible perspiration by stimulation of the sweat centres.

Local perspiration may be induced by circumscribed hot applications or by retention of the natural heat of a part.

The electric-light bath is without doubt the most efficient and satisfactory of all modes of inducing perspiration, for it produces the most powerful stimulation of the perspiratory glands and other structures of the skin. In the electric-light bath, perspiration appears in a remarkably short space of time, thus not necessitating the exposure of the body to the exhausting effect of prolonged exposure to heat. Profuse perspiration generally appears in the electric-light bath in from three to five minutes, and often when the temperature of the air surrounding the patient is not above 85° F., while the dry pack not infrequently fails to produce vigorous activity of the skin within less than an hour and a half or two hours, a longer time being sometimes required.

When one considers the amount of secreting surface presented by the skin, the area of the perspiratory ducts being more than eleven thousand square feet, it is evident that this organ is the most extensive of all the eliminating structures of the body. The skin throws off each hour from an ounce to an ounce and a half of insensible perspiration in the form of an invisible vapor. In this form of activity the whole skin takes part, acting essentially in the same manner as does the mucous membrane lining the lungs, the function of which the activity of the skin still further resembles in the fact that carbonic acid gas is also eliminated by it. In profuse perspiration, the sudoriparous glands are brought into vigorous activity, sometimes pouring out their secretion at the rate of from thirty to sixty ounces per hour, or from twenty to forty times the ordinary amount excreted.

The perspiration produced by the sweat glands closely resembles urine in its character, containing urea and various other toxic matters, and particularly, as has been shown by Bouchard, a ptomaine or toxine capable of causing a fall of body temperature when injected into the veins of an animal. Formic acid, butyric acid, and various other acid substances and poisonous matters are also eliminated in the sweat.

The healthy activity of the skin is one of the conditions most essential to physical well-being. The condition of inactivity and disease which is found present in nearly all chronic maladies is not only a consequence but a cause of a large number of serious morbid conditions, and it is quite impossible to effect a cure in a great majority of cases without bringing the skin into a healthy condition by patient and persevering treatment and training.

The dry, sallow, dingy skin so often observed in the chronic dyspeptic; in fact, in most forms of chronic disease, is not only a symptom of the disordered bodily state, but is a cause of the perpetuation of this condition. The dull, dingy appearance of the skin is due to the accumulation of effete matters in it, and to its impaired nutrition. This state exists not only in the skin, but also in the entire body, hence the correctness of the observation of the empirical but not infrequently very sagacious practitioners of the cold-water cure in the early part of the present century, which led them to rely upon the condition of the skin as a perfect index to the patient's general vital condition in the examination of his case, and as a test of his progress toward recovery.

It is practically impossible to effect a permanent cure in a large number of chronic disorders without restoring the skin to a normal and healthy state.

Sweating baths are of the highest value as a means of ridding the skin of its contained impurities, opening up the obstructed lymph channels and spaces, and thereby encouraging the circulation of the nutritive fluids and the development of normal nerve and gland structures, and unloading obstructed sebaceous follicles of their hardened contents, while at the same time arousing to activity the ganglia and secreting cells of the internal organs, through the reflex movements set up by the cutaneous sensory impressions made.

A diseased state of the skin is always connected with a congested or otherwise disordered condition of important internal viscera, while the restoration of the skin to activity is the most normal means of relief from visceral congestion and other functional disturbances.

The value of hot applications as a therapeutic means has not generally been sufficiently appreciated by those who have undertaken to employ water in a scientific manner. Indeed, many hydrotherapeutists, as Fleury and his followers, have maintained that scientific hydrotherapy is confined to the use of cold water exclusively. On the other hand, there are many others who make excessive use of hot applications, particularly the Turkish bath, the Russian bath, hot mineral baths, mud baths, etc., and a vast deal of harm has unquestionably been done by the depressing effects of frequently repeated and prolonged hot baths without the association therewith of the cold douche or some other means of producing tonic effects whereby the excessive sedative and spoliative effects of the hot applications might be antidoted or antagonized. This is a very serious fault, and is almost universally involved in the methods employed at mineral bath establishments and popular bathing resorts, especially at resorts connected with natural sources of hot water.

At the quaint old bathing resort at Leukerbad, Switzerland, the patients sometimes spend six or eight hours "soaking" in the great tanks filled with warm alkaline waters derived from artesian wells at a temperature of about 100 degrees, but on leaving the bath the massage douche is employed, and produces decidedly tonic effects. The massage douche consists of the application of a jet douche chiefly to the spine and the posterior parts of the body, and over the region of the liver, the water being applied with high pressure while the attendant at the same time vigorously rubs and kneads the tissues with the hand, covered with a hair mitt. In taking a massage douche at the end of an hour's seance in the tank, I found it necessary to keep fast hold of a strong iron bar arranged for the purpose, and to keep my feet firmly braced to avoid being thrown down and washed away by the force of the large stream of cold water directed upon me by the attendant. By a powerfully tonic application of this sort, the debilitating effect of the warm bath is prevented.

The cold bath should be universally employed after sweating baths, except when contra-indicated, as in the case of Bright's disease, rheumatism, neuralgia, and cases in which the sedative effect of heat is desirable.

*The Electric-Light Bath as a Means of Obtaining Alterative or Spoliative Effects.*—The electric-light bath may be employed advantageously for the purpose of reducing the weight, as in obesity, or to remove serous deposits in the tissues, as in anasarca, or in the abdominal or pleural cavities, and as a hygienic or prophylactic measure for the purpose of atoning, to some degree, for the neglect of active muscular exercise. It is perhaps most valuable as a hydrotherapeutic means to be employed in obesity. It must be remembered, however, that the sweating produced by heat is by no means so efficient in reducing flesh as perspiration induced by exercise. By a combination of the two means the most pronounced effects obtainable may be realized.

The author has obtained excellent success in the treatment of very obstinate cases of obesity by making the patient, after taking the bath, perform vigorous muscular work, as by lifting heavy dumb-bells, working hard with chest weights, or engaging in other similar exercises. The execution of leg, arm, and trunk movements according to the Swedish system of gymnastics, may be also employed in cases of this sort. In very feeble cases, massage and friction may be administered by an attendant after the electric-light bath, thus intensifying and prolonging the sudorific effects.

In cases of obesity, there is great danger of overheating the blood in consequence of the obstruction to heat elimination prevented by a thick layer of non-conducting fat. Hot applications for the reduction of flesh should never be too greatly prolonged, on this account, and the bath should always be completed by a vigorous cold application.

The sudden removal from the blood of a large quantity of fluid has to some degree the same effect as bleeding from a vein, weakening the heart's action by lessening the volume of the blood and thus exposing the patient to risk from cardiac failure, a condition not infrequently present in cases of extreme obesity, either from actual fatty degeneration or from accumulation of fat about the heart or beneath the serous lining of the chest and mediastinum.

A short general cold application following the application of heat for producing perspiration to reduce weight in obesity has the effect to restore and increase the disposition for muscular effort in addition to the tonic effect upon the general nervous system, thus enabling the patient to add to the spoliative effect of the hot bath the more thorough-going reducing effects of prolonged muscular exercise.

In administering an electric-light bath for the purpose of reducing flesh, it is an excellent plan to interrupt the hot application at intervals by a cold application, a cold shower bath, a cold horizontal douche or affusion being best employed for this purpose. The temperature should be from 50° to 60° F. The application should be long enough to remove from the skin the surplus heat which has been absorbed, and should be continued a few seconds longer, so as to produce a strong reaction. The atonic reaction of the hot bath, whereby heat production and tissue activity in general are reduced, will be antagonized, oxidation will be encouraged, and effete matters and surplus tissue will be broken down and prepared for elimination, which will be effected by the succeeding application of heat.

In the application of hot baths for the relief of dropsy, great care must be exercised, especially in cases of cardiac dropsy. The appearance of dropsy in these cases indicates that the small blood vessels have lost their power of contraction. The heart is weak and dilated. The stimulating effect of strong applications of heat to the surface may cause still further dilatation of the heart, which is already unable to empty itself completely of its contents through muscular weakness. The depression which follows as the result of the atonic reaction of heat will still further weaken the heart, and may result in so embarrassing the organ as to induce grave symptoms. Death from cardiac weakness has not infrequently occurred in Turkish bath establishments. The risk is even greater in the Russian bath.

The ill effects produced by a sweating bath in cases of cardiac weakness may not end with the bath, or may even be less apparent during the bath than subsequently. The writer has known cases in which the application of the hot bath, as a vapor or Russian bath, for two or three days in succession, has produced a very

rapid decline to which the patient has succumbed a week or two later. I find that the electric-light bath is not open to the same risk in this regard, as are the Russian and Turkish baths, as the skin may be excited so quickly that depressing effects are not produced.

A cold application following a hot bath in dropsy due to cardiac disease is especially important as a means of increasing the tone of both the blood vessels and the heart; but it must be remembered that a severe cold application to the surface momentarily brings a very great strain upon the heart during the primary contraction of the small vessels which is induced through the entire body, hence the application must be managed with great care. Extreme temperatures must not be employed.

The electric-light bath is also an invaluable remedy in certain cases of dropsy of renal origin. It is of special value in acute dropsy due to the nephritis sometimes encountered as a complication in scarlet fever, small-pox, diphtheria, and in the puerperal or prepuerperal state. In these cases it is beneficial chiefly by withdrawing a large quantity of blood to the surface and thus relieving the congestion of the inflamed organ. It is, of course, also of some service through the elimination of toxines, which takes place by way of the sudoriparous glands; but the amount of urea and other toxines thus eliminated, even during the most profuse perspiration, is comparatively small.

Care must be taken to keep the head moistened with cool water during the application, but the head should not be cooled to such a degree as to antagonize the effect of the pack.

In chronic dropsy or chronic nephritis, the electric-light bath is less serviceable in consequence of the organic nature of the affection and the almost certain reappearance of dropsical symptoms after it may have been removed. In these cases there is also great constitutional weakness in consequence of the disease, so that the system is very poorly prepared to endure the depressing effect of a sweating bath; but the electric light for two or three minutes duration is of very great service.

The hot air, or Turkish, bath also has the effect to leave the patient in a condition of diminished resistance to thermic impressions, thus exposing him to risk from cold, one of the most seriou

dangers to be feared by the chronic sufferer from Bright's disease. Some eminent authorities on this account wholly forbid the use of hot baths in this class of cases. The writer has, however, found the electric-light bath invaluable even in these cases, in one special condition, namely, when the sufferer from chronic nephritis has suddenly become dropsical through an acute onset or exacerbation of the disease, the result of exposure to cold or through some departure from the required diet or regimen, or other similar cause. Under these circumstances, the electric-light bath may be employed with advantage, and, if properly managed, without injury. The bath must be short, (five to fifteen minutes), and it must be administered in such a manner as to give the patient as little fatigue as possible, and should never be carried to the extent of weakening or exhausting the patient.

The electric-light bath is far superior to any other form of sweating bath for cases of Bright's disease, for the reason that the skin may be excited to a high degree of activity by a very short application and without exposing the patient to the risk involved in the breathing of highly heated dry air or a hot atmosphere saturated with moisture, as in the Turkish or Russian bath. During the last five or six years the author has employed this bath in a great number of cases of this kind, and without witnessing any untoward effects, but with advantages which are not afforded by other methods of applying heat. The medium about the patient is not overheated, hence the air may be readily maintained at a temperature of 85° to 90°, so that heat elimination goes on normally, which cannot be the case in any other form of hot bath.

In the hot immersion bath, heat elimination is entirely suspended except through the lungs; in the Russian bath, heat elimination from both the skin and the lungs is almost wholly interrupted; in the Turkish bath, heat elimination takes place by evaporation only, both the skin and the mucous membrane receiving heat by conduction from the highly-heated atmosphere surrounding the body; in the electric-light bath, heat is produced in the depths of the tissues as well as at the surface through the numerous layers of tissue which it penetrates, reaching with some degree of intensity at least, the innermost recesses of the body, but heat elimination and skin respiration are not interfered with.

In dropsy due to anemia, the electric-light bath may be employed if carefully administered, but the bath should be very short, owing to the extreme degree of cardiac weakness usually present in these cases, and the general vital and nervous weakness resulting from the impoverished condition of the blood and the general interference with nutrition. Here again the electric-light bath shows itself superior to other measures of applying heat for inducing perspiration, for the reasons already pointed out.

In dropsy from anemia this bath is particularly serviceable as a means of preparing the body for an application of cold, the combination of these two measures having been shown by Winternitz and others to be among the most effective for the enrichment of the blood, if not by the actual production of blood-corpuscles, by bringing into the blood-current a vast number of blood-cells previously hidden away in the vessels of the liver, spleen, and other internal viscera, perhaps exposed to excessive destruction by the large phagocytes situated in these organs which have for their function the destruction of blood-cells.

The electric-light bath may be advantageously employed in cases of dropsy of the abdomen and of the chest, through its powerful spoliative effects. One not infrequently sees absorption set up at such a rapid rate that within a few days there is a very marked diminution or a complete disappearance of the effused fluid which had previously resisted with stubbornness tapping, counter-irritation, and all other ordinary means of treatment. The sweating bath is certainly not a panacea for cases of this sort, but it is a most serviceable measure.

It must be remembered that a cold application must always be administered after the electric-light bath when employed for spoliative purposes, as well as in most other cases. Great care, however, is needed in the adaptation of the cold application at the conclusion of the bath to the serious morbid conditions which are almost invariably present in connection with dropsy, whether local or general in character. It is not necessary to repeat the remarks already made with reference to cold applications after the bath in cases of obesity. Respecting the application of cold in cardiac cases, it is only necessary to add that in many cases the cold towel rub or sponge bath, and, in persons sufficiently strong

and vigorous, the wet sheet rub, in all cases followed by vigorous dry friction, are measures to be preferred to the cold douche, the cold immersion, or other stronger measures of treatment.

In cases of dropsy resulting from renal disease, cold applications must be administered with the very greatest care. If the application of cold is so intense as to produce the slightest inclination to chill, it will be followed by congestion of all the viscera, and consequently increased activity of the renal disease. The cold douche and similar percutient applications must be entirely avoided. Cooling off after a hot bath must also be managed with great care. The best method of cooling the patient is to wrap him in blankets after the hot bath, then cool the skin by applications to limited portions of the surface, taking first one arm, then the other, one limb and then the opposite, and thus proceeding to extend the cooling to various parts of the body until the whole surface has been treated. It is sometimes necessary to go over the whole surface two or three times to complete the cooling in a satisfactory manner. The covering should be at the same time gradually withdrawn also. If too strongly sedative effects are obtained by the bath managed in this way, a tonic effect may be secured by supplementing the bath, after the general surface has been cooled and dried, by hot and cold sponging of the spine.

The patient must not be allowed to dress nor to leave the treatment room until the surface has thoroughly cooled and the pulse returned to its normal rate, so as to avoid the possibility of taking cold. The skin must not be only superficially dry, but must be thoroughly dried out by the evaporation of the absorbed moisture, as indicated by the condition of normal smoothness and firmness. On account of the great liability to chilling after a warm bath, it is better in cases of renal disorder that the patient should be confined to his room for several hours after treatment. The treatment is, on this account, best administered in the evening, so that the patient can retire at once to his bed. By morning the normal equilibrium will have been so completely established as to reduce the risk of taking cold to a minimum.

In cold applications immediately after the electric-light bath, in cases of abdominal dropsy and dropsy of the chest, special regard should be paid to the local condition present. In abdominal

dropsy cold applications should be made first and chiefly to the arms and the upper portion of the back, while in dropsy of the chest the chief portion of the application should be made to the lower half of the body, the purpose being to prevent too strong a reaction in the congested and disabled parts by first producing reaction in the parts of the body most remote from the diseased structures.

The electric-light bath is of great value in icterus, as a means of relieving the intolerable itching, and aiding the elimination of bile. The hot bath should be employed only until profuse perspiration is induced. The neutral bath should then be administered from twenty to thirty minutes at a temperature of 92° to 95°. Hot sponging frequently relieves pruritis when other measures fail.

*Depurative or Eliminative Effects of the Electric-Light Bath.*—The value of the electric-light bath as an eliminative measure is perhaps not so great as it has been popularly believed to be, as the percentage of urea and other toxines contained in the sweat, especially when profuse perspiration is induced, is small, indeed very small, when compared with the percentage of these tissue poisons ordinarily found in the urine. That a considerable amount of the waste elements which are ordinarily eliminated through the urine may be, however, under some circumstances, carried off through the skin, is evidenced by the peculiar urinous odor which is noticeable when profuse perspiration is induced in a patient suffering from renal insufficiency.

The writer has often seen the most excellent results follow an application of the hot blanket pack and other forms of the sweating bath in cases of uremic poisoning, arising from sudden suppression of renal activity as a complication of the later stages of pregnancy, and in urinary suppression occurring in surgical cases, especially after a severe abdominal operation, as a hysterectomy or a prolonged operation for removal of diseased uterine appendages.

The electric light, as well as other forms of the sweating bath, may occasionally render valuable service as a means of averting or aborting a threatened attack of uremic convulsions. A patient under the writer's care many years ago, who had for some years suffered from chronic Bright's disease, discovered for himself that

the characteristic group of symptoms accompanying uremic poisoning might be thoroughly controlled by a hot bath, and had accordingly fitted up in his own home a vapor bath, into which he entered whenever threatened with an attack of convulsions, remaining in the bath until the symptoms entirely disappeared. He stated that he sometimes remained in the bath more than forty-eight hours continuously. Such prolonged applications are not, however, to be commended as generally useful, at least not without interruption every hour or two by the application of cold in the form of heat and cold to the spine, or a cold trunk pack, applied by means of a single thickness of linen wrung very dry out of very cold water, and well covered, so as to secure prompt reaction.

The eliminative effects of the electric-light bath may be resorted to with advantage in all forms of toxemia due to the retention of tissue poisons, as gastric neurasthenia, migraine, jaundice, and chronic biliousness. To be of the greatest service in these cases, the sweating bath should not be too prolonged, and should be immediately followed by short tonic applications of cold water, in the form of the cold douche, cold wet sheet rub, or a cold plunge. The electric-light bath is one of the most suitable means of applying heat in cases of this sort, as it induces profuse perspiration without long exposure of the body to a high temperature, and produces tonic as well as eliminative effects.

The electric-light bath may be applied to a limited portion of the body when desirable, as in the treatment of exudates, enlarged and stiffened joints, pleuritic adhesions in the chest, chronic peritonitis, and certain forms of neuralgia.

The most serious objection to the application of heat in the form of the electric light or otherwise, in many of the cases mentioned, especially in rheumatism and gout, is the danger of diminishing the general bodily resistance, leading to the contracting of colds through slight exposures, by which any good effect which may have been effected by the treatment may be lost. This danger can be averted only by most judicious care in gradually cooling and protecting the patient after the bath, and by the careful use of cold applications.

In diabetes with emaciation, and when the perspiration does not

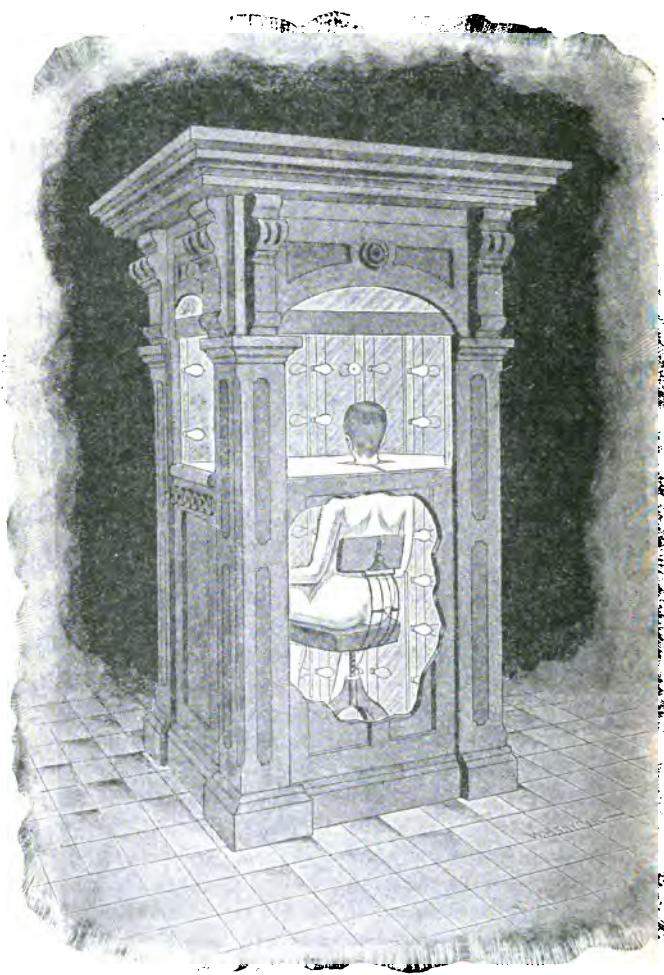


FIG. 1.—Upright Cabinet for Electric-Light Bath.

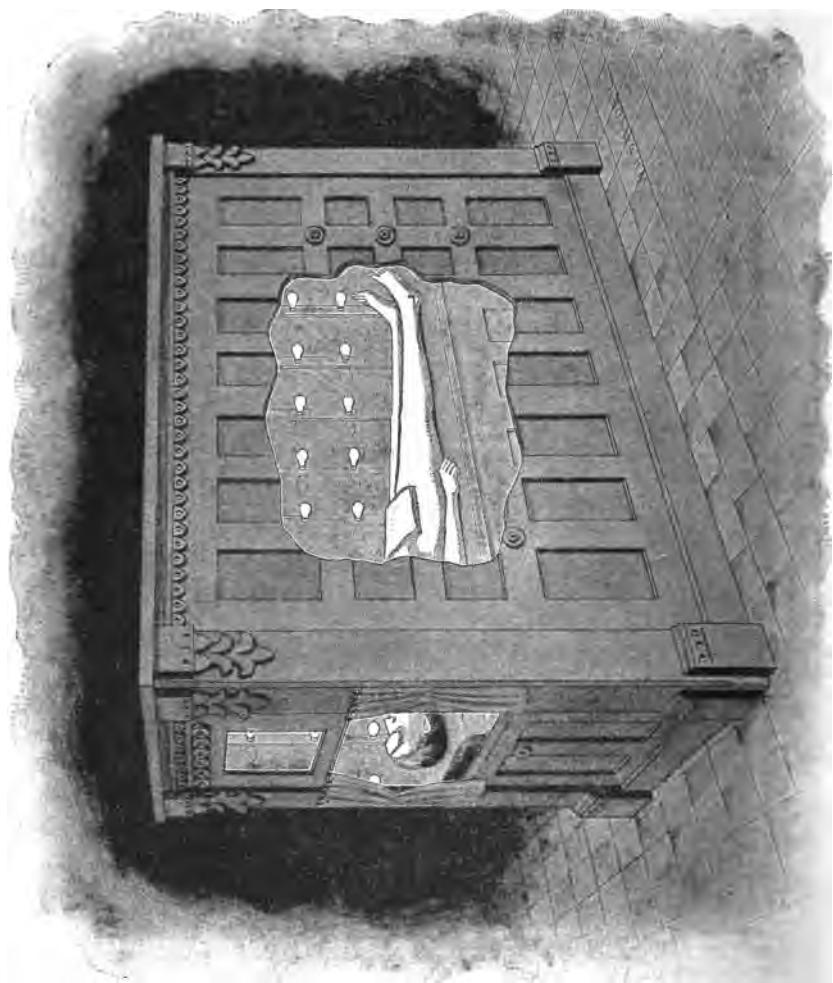
contain sugar, the sweating baths must be avoided or used with extreme care.

In cases of skin disease accompanied by painful eruptions, furuncles, or other evidences of extreme excitation and irritation, if the sweating bath must be employed, the electric-light bath should be preferred. Turkish and hot air baths irritate the skin, while the wet sheet pack and some other forms of hydriatic applications are too exciting.

For several years I have been employing the electric-light bath in various forms. I have made the most extensive use of a general application of radiant heat by means of the electric-light, using for the purpose cabinets of different forms and constructions. In some the patient sits upright upon an adjustable stool, with the head exposed to the light or not, as may be desirable; in others the patient lies horizontally upon a table, the light falling upon him from every direction, that from below reaching the body through the glass slab which forms the cover of the movable table upon which the patient lies. I have also made extensive use of the bath in various limited forms (some of which are shown in the accompanying figures). One of the most serviceable of these is an arrangement for applying the light to the trunk with the patient in a sitting position. I find this to be especially valuable in cases of disorder of the liver, kidneys, stomach, and bowels. Applied in this way the application is usually followed by a cold trunk pack or a cold spray or douche to the surface which has been exposed to the heat.

As a local application to the diseased joints of rheumatism and gout, the electric light is, I believe, superior to all other remedial agents. By suitable appliances, the radiant energy may readily be concentrated upon the affected joint or joints, and in chronic cases especially, there is no agent which secures such rapid and permanent results in the relief of pain, swelling, and the reduction of morbid conditions as does this bath. When applied in this manner, it should be followed by a cold application for about fifteen seconds. The cold application may be a dash of cold water, or better, a towel wrung out of very cold water as dry as possible, and wrapped around the part for a quarter of a minute; afterward cover warm.

FIG. 2.—The Horizontal Cabinet for Electric-Light Bath.



The electric light is also of great value in cases of tubercular disease of the joint. The rationale of its action in these cases is that it first stimulates the tissues to such a degree as to enable them successfully to resist the attacks of the specific germs of tuberculosis, and second, that it attenuates and perhaps even destroys the germs. It is well known that sunlight is capable of destroying these microbes, and when the intense light of the electric ray is brought to bear upon the germs, even though they are buried in the tissues, it may attenuate or even destroy them. The results of some scientific observations which have been made upon the point confirm this view.

I have found the electric-light bath particularly useful as a preparation for cold applications of all sorts. Its special value for this purpose lies in the fact that it heats the skin more quickly and to a greater depth than hydriatric or other applications, at least such as can be safely employed.

In rheumatic and anemic patients, persons whose heat-making capacity is small, the electric-light bath serves an exceedingly useful purpose in preparing the skin by storing up in it supplies of heat, so as to prepare it for a cold application, and it serves a useful purpose in this way, not only in preparing the patient for tonic applications of water, but as a means of producing most excellent revulsive effects. For pure revulsive effect, one desires only circulatory reaction. It is, in fact, necessary to suppress thermic reaction altogether; hence cold applications which follow hot applications should be only of such length as to neutralize the heat which has been absorbed by the skin in the previous



FIG. 3.—Electric-Light Spine Bath.

hot application. The electric-light bath having the power to store up quickly a large amount of heat in the skin, it is consequently of special service in applications of this kind, which are the most effective means of relieving internal congestions, and the most powerful of all external agents for the relief of pain.

A local application of the electric light for three or four minutes, followed by an application of an ice compress for fifteen

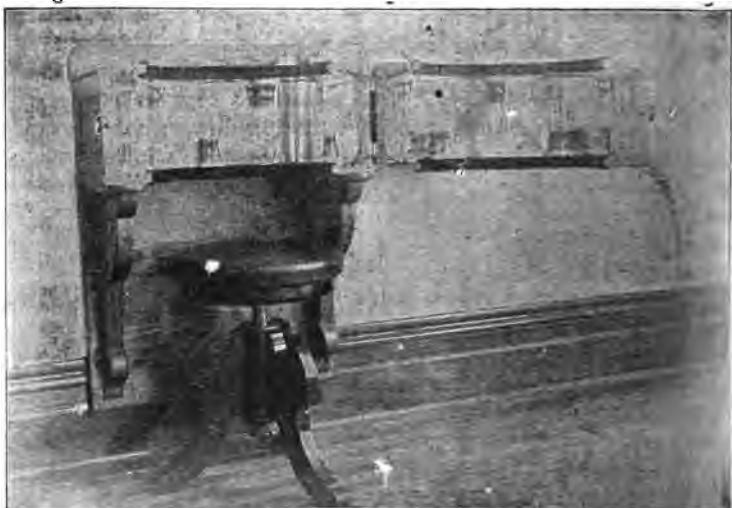


FIG. 4.—Electric-Light Trunk Bath.

seconds, is almost a panacea for the pain of sciatica and for other similar painful affections in which there is no inflammatory action.

For general revulsive effects, I have devised a new form of bath, which combines the shower and douche with the electric-light bath. The cabinet is made of such a shape that the patient stands in an upright position. After the skin has become thoroughly warmed by the heat from the lamps, a cold shower or horizontal jet douche, of the desired temperature, is applied, the lamps being protected from the cold water by an internal lining of plate glass. The

revulsion thus produced is of the most powerful character, and can be repeated as many times as required. By making the hot and cold applications of equal length, this bath can be made more



FIG. 5.—Electric-Light Trunk Bath in Use.

exciting than any other therapeutic application can be made, and thus the most powerful tonic effects can be produced.

By combining the electric-light bath and the cold douche, cold compress, rubbing with ice, or any similar cold application, the most powerful alterative and resolvent effects can be produced. I

have found this measure to be of immense value in the treatment of chronic arthritis, especially when accompanied by exudates.

The electric-light bath is certainly not a panacea, but it is nevertheless a therapeutic measure of high value. I esteem it, next to water, the most valuable of therapeutic agents. The general introduction of incandescent electric lighting makes its use convenient, and I am glad to say that it has now been introduced into quite a number of hospitals, sanatoriums, and physicians' private offices. Within the last year more than 40,000 general applications of the bath have been made, besides a very large number of local applications. The bath is being rapidly introduced in Austria and Germany, under the patronage of Dr. Winternitz, Professor of Hydrotherapy in the medical department of the Royal University of Vienna. In a letter recently received from Dr. Winternitz, he tells me that he finds the bath entirely satisfactory. I have received numerous letters from manufacturing firms in Germany, advertising the bath, and from the statements made I infer that it is being quite extensively introduced. I have also recently learned that several manufacturers are taking steps to introduce the bath in England.

A great advantage which the electric-light bath enjoys over other methods of applying heat therapeutically is the small expense of installation. Turkish and Russian baths require expensive heating apparatus—furnace, steam-boiler, smoke-stack, in addition to fireman and engineer, and frequent visits from plumber and steam-fitter to keep everything in order. The electric-light bath is complete in itself, requires no greater expense in installing than the running of two small wires for a short distance.

Another very decided advantage is the small expense of maintenance. The expense for maintenance is simply the cost of the current. This expense is incurred only while the bath is in actual operation, whereas the expense of the Turkish or Russian bath is more or less continuous, as the bath must be held in constant readiness for use. The usual length of an electric-light bath is from two to ten minutes, according to the effect required, the average length being about five or six minutes. This would make the cost of a single bath two and a half to three cents, instead of \$1 to \$2, the cost of a Turkish or Russian bath. There is practically

no cost for repairs. There is nothing to wear out in the electric-light bath, except the lamps, and these are guaranteed to last a thousand hours, which would furnish one electric-light bath every day for fifteen years.

The electric-light bath is always ready for use. It is only necessary to turn on the current, and the light shines out instantly and with its full intensity; another touch of the button, and the heat is removed wholly or in part as quickly as it came. Thus the heat may be instantly and perfectly modified to suit the requirements of each individual case.

The bath requires a very small space—the vertical style only about four square feet, the horizontal style of cabinet about four by fourteen feet. The vertical cabinet may be operated in a physician's back office or small adjoining room, or, if desirable, it may be set up in a patient's bed-room or bath-room, either permanently or temporarily.

While the electric-light bath may not, perhaps, entirely displace the vapor bath, the Russian and Turkish baths, hot water, and other hydro-therapeutic measures, it may certainly be claimed for it that it has won for itself a permanent place in therapeutics, and is destined to grow in favor as its virtues and advantages become known.

## The Effect of High Tension Discharges on Bacteria.

By J. INGLIS PARSONS, M.D., M.R.C.P. (Lond.), and C. SLATER, M.A., M.B. (Cantab.),  
London, England.

A negative result is very often of value, and on that account I bring these notes before you. When investigating the effect of high tension discharges on organic tissue, I quite expected, from the results obtained, that I should be able to kill bacteria with great facility. It seemed more than likely that a power capable of breaking up the individual cells of beef fibre into minute particles that could hardly be seen with a quarter-inch objective would produce instantaneous death of any bacteria. But such was not the case ; in fact, a current strong enough to knock a man down had no effect whatever on these minute organisms.

The apparatus used consisted of a special faradic coil made to my order, and capable of giving a 7-inch spark through air. The resistance in the secondary coil was very much lower than usual and only amounted to 1,000 ohms ; the object of this being to avoid expending too much of the energy in overcoming the resistance of the great length of wire necessary to produce the high voltage obtained.

The current breaker is arranged so that it can be worked by hand or automatically. By the former method a single interruption can be given if required.

The various bacteria were cultivated in U-shaped tubes to facilitate the application of electricity. The electrodes were made of platinum and sterilized in the usual way in a spirit lamp.

The resistance of the U-shaped tube of bouillon amounted to 770 ohms, while that of gelatine was 800 ohms.

### SERIES "A."

Both electrodes brought into contact with the culture medium direct from the secondary coil :

No. 1.—*Staphylococcus pyogenes aureus* in bouillon ; coil set for 6-inch spark ; automatic interruptions for twenty seconds.

No. 2.—Same organism in gelatine ; same current.

No. 3.—*Micrococcus prodigiosus*; gelatine medium; same current.

No. 4.—Same organism in bouillon.

No. 5.—*Bacillus coli* in bouillon.

No. 6.—Same bacillus in gelatine.

#### SERIES "B."

As no result was obtained in the former series, it was thought that the culture media might interfere with the action of the current. Some cubes of beef (four inches) were obtained, a slit was cut in the centre and inoculated :

No. 1.—*Pyogenes aureus*; needle points  $2\frac{1}{2}$  inches apart; coil set for 6-inch spark through air; forty interruptions in each position of the needles; needles inserted in four positions on each side of the cube.

No. 2.—The same experiment with *bacillus pyocyaneus*.

No. 3.—The same experiment with *bacillus coli*.

No. 4.—The same with *micrococcus prodigiosus*, except needles were four inches apart.

No. 5.—With *bacillus mycoides*; needles in one position four inches apart; sixty interruptions.

No. 6.—Loeffler bacillus; needles in two positions; sixty interruptions.

#### SERIES "C."

In this series an air gap of three inches was interposed in the circuit. This experiment was tried because it is not yet known to the greatest living authorities on electricity what voltage is developed against the comparatively low resistance of beef and other organic structures. With an air gap of three inches, a pressure of over 60,000 volts is developed, although I quite expected that the energy of the current would be mainly used up in overcoming the resistance of the air gap, I still thought it worth while to try the experiment, especially as the coil was capable of sparking over seven inches of air.

Two carbon electrodes were used, one at each end of the culture tube, and of a size that nearly filled the tube. The current was allowed to run automatically for thirty seconds in each

experiment. The distance between the electrodes was  $1\frac{1}{2}$  inches. The culture fluid was agar agar, and growths of the following bacteria were tried :

1. *Staphylococcus aureus.*
2. *Micrococcus prodigiosus.*
3. *Bacillus pyocyanus.*
4. *Bacillus coli.*
5. *Bacillus diphtheriae.*

#### SERIES "D."

In this series the experiments were the same except that instead of an air gap in the circuit a Leyden jar was interposed between the coil and the culture tubes. It has the effect of altering the character of the discharge. The voltage is lowered, the quantity is increased, while the rapidity of the discharge is increased to thousands of interruptions in the second. When allowed to spark through air the discharge quite lights up a dark room and makes a noise like a pistol going off.

I was very much astonished to find that none of these experiments had any destructive effect on the bacteria. The discharge did not appear to affect the organisms in any way, and produced no effect on their virulence, pigment producing functions, or rapidity of growth.

Dr. C. Slater, bacteriologist to St. George's Hospital, prepared the cultures and examined them after the passage of the current. I take this opportunity of expressing my great indebtedness to him for the time and care which he expended on the investigation.

## Report on the Action of X-Rays on Tuberculosis.

By J. BERGONIÉ, M.D., Bordeaux, and — TESSIER, M.D., Paris, France.

### INTRODUCTION.

Since the publication of the discovery of Professor Roentgen (December, 1895), the applications of this discovery to medicine have been nearly without number ; it is needless to here recall the importance of radioscopy and radiophotography in diagnosis in surgery and medicine.

But, since at times when the X-rays (so named by Roentgen because he did not know their nature) were used in the diagnosis of diseases of internal organs, certain phenomena were observed which proved that these new rays could of themselves have an action on such living tissues as were struck by them. And, again, having used in therapeutics other rays, such as spectral rays, heat rays, luminous rays and actinic ones, we were led to believe that these X-rays could themselves also bring about modifications of the exposed tissues, and that to radiotherapy by spectral rays of all length of waves, there must be added radiotherapy by the X-rays.

In fact, the idea of applying the X-rays, as we apply other radiations, to the treatment of certain affections, arose rather from the misdeeds of these rays used in the diagnosis of diseases of the bones and in the search for foreign bodies in the tissues.

**MISHAPS CAUSED BY THE X-RAYS.**—We had observed, in fact, from the beginning that the photographing by the X-rays of a limb or of a segment of a limb in the living, left certain conditions—traces of its action—on the skin. In the mildest cases, an erythema showed itself a few hours or a few days afterwards ; the hairs of the region fell out. These were the symptoms of the first degree of the accident. Also sudamina vesicles of varying size and more or less extended form, when the exposure was for a longer time, or the tube was approached more closely. And, indeed, large losses of substance, difficult to heal, were observed in the graver mishaps.

Although confirmed by the majority of observers these facts were, however, made doubtful by others who probably had used sources of electricity less intense or had placed themselves under conditions better calculated to avoid them. Also, was not the experiment which Prof. Elihu Thomson made on himself useless, because it proved the certain danger there was in exposing the living tissues, without precautions, to the X-rays? This classic experiment well deserves recalling in detail.

Prof. Elihu Thomson wished to verify himself the action of the X-Rays on the skin and the living tissues, the action about which he had some doubts. He exposed his left little finger during half an hour against a Crook's tube that he had in his possession.\* He got no apparent result for a week, the skin remained intact. But at the end of this time the finger reddened, became extremely sensitive, swollen, stiff and painful; two-thirds of the exposed surface became occupied by a large bulla, which extended day by day. Seventeen days after the exposure the finger was still sore, but showed a tendency to heal; the destructive action limited itself to the part exposed, and did not spread beyond the surface; the adjacent finger, very much less influenced, became red and painful, but without vesicle; it was soon cured.

This experiment of Prof. Elihu Thomson, more complete than those previously done, especially that of P. Fuchs, not only convinced the author, who declares himself personally more than satisfied with the results of his own experiment on himself, but also of those who had some doubts. After him B. Owens,† Gilchrist,‡ Broca,§ Balthazar,|| Richer and Londe,¶ and a great number of others confirmed the destructive action of the X-rays on the skin, mucous membranes and the tissues, whatever they might be, exposed directly to these rays.

It is these observations which show their positive effect on the starting point of radiotherapy by the X-rays.

\* *Electr. World*, p. 668, November 28th, 1896.

† *Electr. World*, December 19th, 1896.

‡ *Bull. de l'hôpital. de Johns Hopkins*, 1896.

§ *Soc. franç. de phys.*, December 4th, 1896.

|| *Soc. de biol.*, July 25rd, 1897.

¶ *C. R. de l'Acad. des sciences*, May 31st, 1897.

**THE NECESSITY FOR EXACTLY DEFINING THE CONDITIONS OF EXPERIMENT.**—Before passing on to the results furnished by this method, it seems necessary to us to indicate under which experimental conditions the greater number of the authors have placed themselves, and to recall, on these broad lines at least, the technique which it is usual to employ in like cases. The conclusion of this report, in fact, having for base the experiments done at the present time with existing instruments cannot attain nor prophesy results for the future. Since the improvements which might be brought to bear on this line of experiments might bring about differences of a pronounced nature in the intensity of the rays emitted, it is not possible to limit the results we may obtain from them.

Again, it may be the same with the X-rays as with the action of luminous foci. Previously, accidents caused by those which we had at our disposal were, as it were, unknown; to-day cases of insolation, ocular accidents, etc., caused by electric arcs of great intensity, are now innumerable.

Now, what is the instrumental technique that the greater number of observers have used to obtain the results published in the works that form the basis of this report?

**INSTRUMENTAL TECHNIQUE.**—Let us take from the start Crooke's tubes, which emit these X-rays, on the nature of which nobody is yet sure. They have varied very much since Roentgen's discovery. To start with the tube of plane cathode and simple anode, which Roentgen used to the tube regenerated automatically, a very complicated one in its construction, and to the Villar's tube, constructed by Chabaud, regeneratable by osmosis; the last, a great number of models in forms and dimension have been constructed. The most widely used certainly, if I judge the few indications furnished in their memoirs by authors, is the bianodic tube, small and large, sometimes called Muret's tube.

This tube is fed from a source which scarcely varies, it is for the greater part of the time a Ruhmkorff coil, large or small, giving sparks fifteen to forty-five centimetres, and fed now by cells, now by accumulators, or from an industrial source. The static machine which some authors, yet rarely, employ for radiography or radioscopy has scarcely been employed in radiotherapy, still it has the

reputation, possibly merited, of producing disorders of the skin much less severe than the Ruhmkorff coil.

**NEED OF METHODS OF PRECISION.**—But if the result of instrumental technique pointed out by the authors is sufficient to give an indication of the manner in which they acted, it is not sufficient to establish quantitatively the condition in which this or that observation was made. In effect, the action of the X-rays on the skin or the tissues more deeply placed, can be compared to the actinic actions of spectral radiations to those, for example, of the complex radiations arising from a luminous source on the thick layer of a gelatino-bromide of silver, in the photography of colors by Professor Lippmann's method. To measure this action and to compare the various results amongst them to which they may give rise we must know, on the one hand, the intensity of the flux of rays observed, the time during which the rays acted, and finally the nature of the rays, or rather the co-efficient of action of each of them on the tissue exposed. For the rays which emanate from the Roentgen tube, as Roentgen himself demonstrated, and after him many authors, Imbert and Bertin-Sans amongst them, are not a homogeneous pencil, nor, as we might be tempted to say, *mono-chromatic*; we perceive it by the variable penetrating power which the rays have on different substances; we perceive it again in the irregular production of accidents which appear on the skin after a sitting for a photograph.

**INSTRUMENTS FOR MEASURING RECOMMENDED.**—It will then be necessary to define, at least in practice, until such time as we can do it rationally, the nature of the X-rays, which we used in the researches undertaken in bacilli or clinically. For all that no instrument, so far as we know, gives the necessary indications to determine the nature of these rays, still we believe that it is possible to recommend the use of photometers recently employed for this purpose. That of MM. A. Imbert and H. Bertin-Sans seemed to us very practical, for it suffices to count the number of lead wires seen on the screen to have an indication of the relative value of the pencil used.

Without doubt, the appreciation of the intensity of the rays of diverse natures that a tube emits is not made by this simple method, but from the practical point of view the indications of

this apparatus are certainly useful; as much might be said of Buguet's photometer based on the same principle, but more portable.

Let us pass on to the direct examination of the results obtained. We shall examine first the action of the X-rays on the cultures of the bacillus tuberculosis and tuberculous animals, then we shall see the action of these same rays on some forms of clinical tuberculosis.

### ACTION OF THE X-RAYS ON TUBERCULOSIS.

#### EXPERIMENTAL DATA.

**ACTION OF THE X-RAYS ON THE BACILLUS TUBERCULOSIS AND ON EXPERIMENTAL TUBERCULOSIS.**—A certain number of experimental researches, with the view of studying on animals the physiological or the therapeutic effects of the X-rays, were carried on on different sides since the important discovery of the Professor of Würzburg.

The object of these researches was to establish: 1st. The influence exerted by the X-rays under given conditions on the morphology, the vitality and the virulence of many micro-organisms; 2nd, the influence of these rays on animals previously exposed to infections of a variable nature.

We have not here to enter into details of the experiments having bearing on all the micro-organisms experimented on except the bacillus tuberculosis. We may make mention of them only to recall the failure of the greater number, if not all, attempts of this character, the initiative of which is due to Minck\*.

Sormani, † Achard, ‡ Sabrazès and Rivière, § Berton, || Blaize and Sambuc, ¶ Courmont and Doyon, Trautzius\*\* were able to record but the nullity of the action of the rays on the chromogenic properties of certain saprophytes, on the vitality or the virulence of the greater number of the pathogenic microbes.

\* Minck, *Semaine médicale*, February 12th, 1896.

† Sormani, *C. R. Institut royal de Lombardie*, July 4th, 1896.

‡ Achard, *Soc. méd. hôpital*, January 22nd, 1897.

§ Sabrazès and Rivière, *Acad. des sciences*, May, 1897.

|| Berton, *Acad. des sciences*, July, 1897.

¶ Blaize and Sambuc *Soc. de biol.*, 1897.

\*\* Trautzius, *Centralbl. f. Bakter.*, May, 1897.

In the works of these experimenters there is no mention made of the tubercle bacillus. This research was made at about the same time by Rieden, Fr. Pott, Blaickie, by ourselves in collaboration with M. Ferré, or more recently with the help of M. Serbanesco.

Recalling the powerful action of solar light and even of diffuse light on the culture of the tubercle bacillus (Koch, de Renzi, etc.), also remembering the results so exact of Straus, who suppressed all vitality in very rich cultures of the bacillus tuberculosis, human and avian, by an exposure of two hours to the rays of the sun in summer, it was justifiable in us to hope that we would be more happy with the bacillus tuberculosis than we were.

If we except the results of Rieden, whose elements seem to us to be insufficiently exact, and Blaickie's fact, which we have found it impossible up to the present time to verify, all these researches remain equally negative.

In May, 1897, one of us (Bergonié)\*, in collaboration with M. Ferré studied the action of the X-rays on the vitality and the virulence of the cultures of the bacillus tuberculosis. The experimental conditions were the following :

A culture of the bacillus tuberculosis on glycerine agar, after previously removing a first third, injected under the ventral skin of a guinea-pig of six hundred grms. as control, is exposed for an hour to the Roentgen rays. These rays were emitted by a large size Muret tube excited by a Ruhmkorff coil giving a 35 centimetre spark and furnished with a mercury commutator of the Foucault type. The intensity was such that one could obtain with it a radiograph of the hand in five minutes. The glass tube enclosing the culture, almost completely opaque to the X-rays in spite of its thinness, was exposed in such a manner that the rays traversed the cotton plug and the rubber cap which closed the orifice.

The exposure made, the culture was replaced in the incubator, and twenty-four hours afterwards each of the two-thirds remaining was injected under the ventral skin of two guinea-pigs weighing 635 and 545 grms., respectively. These three guinea-pigs all succumbed to the progress of tuberculosis ; at the autopsy the viscera were crowded with tubercles. The animals inoculated with the

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\* Bergonié and Ferré, *Archiv. d'électr. méd.*, May, 1897.

exposed culture survived the control pig only eight days in one case and one month in the other.

The experiment showed that an exposure of a culture of the tubercle bacillus for an hour to the X-rays did not destroy the virulence in this culture. The evolution of the tuberculosis seems only to have been retarded.

As to vitality, it seems not to have been altered at all, for the tube replaced in the incubator gave a luxuriant growth of tubercle bacilli. A second experiment showed even more markedly the innocuity of the X-rays on the vitality of the bacillus tuberculosis.

A culture of the bacillus tuberculosis perfectly developed (*tube No. 1*) was submitted for one hour to rays obtained under the same conditions as formerly. The upper quarter of the culture thus treated is sown in two tubes of glycerine agar (*tube No. 2*).

Four days afterwards tube No. 1 is again exposed for an hour, and a second quarter is extracted and sown on two other tubes (*tube No. 3*).

Again, four days afterwards a new exposure of tube No. 1 is made, a new quarter of the culture is sown (*tube No. 4*).

Again, during twelve days culture No. 1 is submitted daily for an hour to the X-rays and the remaining quarter is sown on the last day on two tubes of gelatine agar.

A month afterwards an examination of the cultures gives the following results : On tube 1, small colonies have developed, a little abundant at the points where previously removals had been made ; on the rest of the surface, the culture had come out beautifully, and the other tubes had grown luxuriously.

In November, 1897, Fr. R. Pott\* presented to the medical Society of Bournemouth a work on the action of the X-rays on the vitality of cultures of the bacillus of tuberculosis.

This experimenter had sown twenty-five tubes of agar with a pure and virulent culture of the bacillus tuberculosis. The twenty-five tubes were put in an incubator ( $37^{\circ}$  c.) for a month, and gave abundant cultures. The cultures were separated into seven groups of three, and one of four. Of each group one tube was kept as control and the other seventeen were submitted to the obscure rays.

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\* Fr. Pott, *Rev. de la tuberculose*, 1898.

To assure an equal distribution of the rays the tubes were laid flat on a table that could be turned.

During the exposure, which varied from one-half hour to eleven hours, the control tubes being withdrawn from the incubator and placed away from the influence of the X-rays in a place of equable temperature. The experiment terminated, all the cultures were again put into the incubator. Three months afterwards all the cultures showed an analogous aspect and did not present any difference in their mode of development.

Fr. Pott was reproached for not having tried the virulence of the cultures thus treated. There was, nevertheless, this result, an absence of all modification in the vitality of the cultures of human tuberculosis after an exposure of eleven hours to the X-rays.

One of us (Teissier), aided in the radiographic part by M. Serbanesco, has followed a few experiments on the effects of the X-rays on the virulence of the bacillus of tuberculosis.

These experiments were carried out under the following conditions :

A culture on glycerine bouillon of the human bacillus tuberculosis arrived at its full development and of approved medium virulence, was divided into about equivalent parts by means of a platinum loop on two Pétri plates filled with agar for the sole object of avoiding dessication of the culture.

These plates, rid of their glass covers, which would have been an obstacle to the penetration of the rays, but wrapped in a sheet of sterilized filter paper, were exposed during one-half hour, one hour, or two hours to the X-rays, that is during the lapse of time that suffices for the direct luminous rays to kill a culture, more or less abundant, of human tuberculosis.

The rays were emitted by a large model Muret tube placed at a distance of 35 to 40 centimetres from the cultures, and excited (to avoid the action of fumes) by a Ruhmkorff coil with a Radiguet interrupter giving a 45 centimetre spark, with a current of an intensity of six amperes. A dilution in sterilized water of each of the cultures exposed was injected in half cubic centimetre dose into the peritoneum or under the skin of a series of guinea-pigs ; six animals were thus inoculated, three into the peritoneum, three under the skin. The control cultures placed in the same manner

on Pétri plates, placed away from the X-rays, served to inoculate four control guinea-pigs. All the animals not having succumbed at the moment of the preparation of this report, we had to sacrifice them ; here is what we were able to observe from the point of view of weight and intensity of lesion.

**SERIES "A."—*Animals inoculated with the culture exposed to the X-rays for half an hour.***

	Original weight.	8 days after.	15 days after.	18 days after. (death).
Weight : Guinea-pig inoculated under the skin	550	530	470	440
" " inoculated in the peritoneum	570	510	480	470

**Lesions.**—Guinea-pig inoculated subcutaneously : Small caseous abscess at seat of inoculation ; inguinal glands enlarged ; no other lesions.

Guinea-pig inoculated intra-peritoneally : Disseminated tubercular nodules in the omentum, the mesentery, the liver and the spleen ; this last a little enlarged. No ascites.

**SERIES "B."—*Animals inoculated with the culture exposed to the X-rays for one hour.***

	Original weight.	8 days after.	15 days after.	18 days after. (death).
Weight : Guinea-pig inoculated under the skin	510	550	510	500
" " inoculated in the peritoneum	560	570	550	530

**Lesions.**—Guinea-pig inoculated subcutaneously : A moderately large caseous abscess at the point of inoculation : inguinal glands large and red ; spleen somewhat enlarged ; non-tuberculous in appearance.

Guinea-pig inoculated intra-peritoneally : Tuberculous peritonitis very marked, showing many yellowish nodules in the thickened omentum, in the mesentery and in the parietal peritoneum ; liver and spleen tubercular (spleen very much enlarged). No ascites.

**SERIES "C."—*Animals inoculated with the culture exposed to the X-rays for two hours.***

				18 days after (death).
	Original weight.	8 days after.	15 days after.	
Weight: Guinea-pig inoculated under the skin	520	530	520	500
" " ; inoculated in the peritoneum	540	440	400	380

*Lesions*.—During life, eight days after the injection, marked induration at point of inoculation in both guinea-pigs.

The guinea-pig inoculated subcutaneously: Voluminous caseous abscess; inguinal glands tuberculous; spleen tuberculous and voluminous.

Guinea-pig inoculated intra-peritoneally: Intense peritoneal tuberculosis, voluminous omentum, forming a thick fibro-caseous mass; liver and spleen crowded full of tubercles; parietal peritoneum much infected and showing disseminated tuberculosis; spleen voluminous. No ascites.

**SERIES "D."—*Control Guinea-pigs.***

				18 days after (death).
	Original weight.	8 days after.	15 days after.	
Weight: Guinea-pig inoculated under the skin,				
No. 1 .....	540	550	520	530
" Guinea-pig inoculated under the skin,				
No. 2 .....	500	500	480	470
" Guinea-pig inoculated in the peri-				
toneum, No. 3 .....	530	359	died spontaneously	
" Guinea-pig inoculated in the peri-				
toneum, No. 4.....	500	490	460	450

*Lesions*.—Guinea-pigs inoculated subcutaneously: (1) Small caseous abscess at point of inoculation; small inguinal glands. (2) Small caseous abscess at point of inoculation; no enlargement of inguinal glands.

Guinea-pigs inoculated intra-peritoneally: (3) Tuberculosis at point of inoculation in form of a small caseous mass; omentum slightly thickened; spleen small; no ascites. On the whole few lesions. (4) Accentuated peritoneal tuberculosis; omentum thickened and tuberculous; tubercles in the liver and spleen, these small.

*Results.*—Summing up, very little variations in weight of the animals submitted and the control ones. Lesions clearly more marked in the animals submitted, and especially pronounced in those where the inoculation material was exposed one and two hours to the rays.

The different experiments just related permits of our concluding with Fr. Pott, that the amelioration noted on different sides on the state of tuberculous patients submitted to the action of the X-rays did not arise from any influence exercised directly by the rays on the bacillus itself. They showed, contrary to Rendu's hypothesis, which was ready to admit an attenuation of the vitality and virulence of the bacillus, that the X-rays were without effect on this vitality or virulence.

We had to have recourse to another explanation, and fell back on that which seemed to come forth from the first experiments attempted on tuberculous animals. The X-rays did not act on the infecting agent, it increased the resistance of the tissues to this infecting element.

On June 22nd, 1896, MM. Lortet and Genoud communicated to the Academy of Sciences the result of experiments performed with the view of studying the action of the X-rays on the bacillus tuberculosis, not now confined in culture tubes, the glass of which was an obstacle to the penetration of the rays, but injected into the tissues of living animals.

Eight medium-sized guinea-pigs, of about the same age, were inoculated aseptically in the right inguinal fold with an emulsion in bouillon, of a spleen taken from a guinea-pig manifestly tuberculous. The next day three guinea-pigs from the lot of inoculated animals were taken haphazard, tied down on their backs to a board, and the inoculated inguinal region exposed to the radiant tube held at a distance of 20 centimetres. The rays were emitted by a Seguy tube, animated by a Ruhmkorff coil.

The exposure of three guinea-pigs to the X-rays was repeated each day during one hour at least, for nearly a month.

Three weeks after the inoculation, the five control guinea-pigs showed at the seat of inoculation a spontaneously open abscess, from which ran a whitish pus; the inguinal glands were soft and thickened. The three treated animals had no abscesses, and their

small inguinal glands tended to become smaller day by day. The former had become thin, the latter had increased in weight.

"The autopsy, only," added MM. Lortet and Genoud, "could show what had become of the tuberculosis in these latter animals. We clearly do not pretend to believe that we have caused all the noxious properties to disappear, but whilst awaiting the results of the microscopic examination we believe that we have the right to say that the X-rays have modified the acute evolution of the tuberculosis, and have favorably modified its march in the guinea-pigs experimented upon." And they concluded: "This result, still so incomplete, may justify the use of the X-rays for localized superficial tuberculosis of the pleura, and also for mesenteric tuberculosis."

Since this communication, which served to justify all the expectations, MM. Lortet and Genoud have remained silent. We do not know whether the guinea-pigs submitted to the X-rays have succumbed or survived. It would have been interesting to know anyway the results of the microscopic examination.

It is to be noted, too, that the animals were placed at a distance of 20 centimetres from the radiant tube, that they were, in consequence, in the sphere of the influence of the electrostatic field, of which the trophic action seems more marked (Tarchanoff Destot). There might arise from this fact a limited revulsive action at the seat of the local lesion, just immediately under the line of the tube, of the character of those which we have noted at the commencement of this memoir, and that we study further on with reference to the radiotherapy of lupus.

On March 15th, 1897, MM. Fiorentini and Luraschi\* published a memoir "on the X-rays" in experimental tuberculosis.

Abandoning the method of subcutaneous injection, which then appeared not too certain, they chose the intra-peritoneal one as the most rational and the more exact.

Their experiments are divided into two series:

*In the first series* six guinea-pigs are inoculated in the peritoneum with one cubic centimetre of a three months' old culture, of the tubercle bacillus in a glycerine bouillon, this having "in consequence a diminished virulence."

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\* Fiorentini and Luraschi, *Archiv. d'électr. méd.*, June 15th, 1897.

Three of these guinea-pigs are submitted to the obscure rays ; three serve as control.

The animals submitted, placed at a distance of 10 to 20 centimetres from a Crooke's tube, and receiving the rays directly on the seat of inoculation previously shaven, were placed in pasteboard boxes, the bottom of which was formed of a thin net of linen thread.

No. 1 was exposed twice a day for twenty minutes each time for eight days ; No. 2, for half an hour for seven days ; No. 3, for forty minutes on four alternate days.

Guinea-pig No. 2 died fifty-three days after injection, showing lesions of diffuse tuberculosis. On the sixty-eighth day the other two were killed, as well as the control animals.

At the autopsy, all were tubercular. But the lesions were somewhat different, and seemed to be less marked in the animals submitted. No. 1, especially in a good state of nutrition, showed no lesion in the peritoneum nor in the viscera ; there were only a few of the inguinal glands tubercular.\*

*In the second series* six guinea-pigs were inoculated ; eight served as animals of control ; two of those submitted received in the peritoneum one cubic centimetre of culture ; the other, No. 2, one-half a cubic centimetre of culture. Of the control animals seven received one-half a cubic centimetre of culture each ; one, one cubic centimetre. The culture used for inoculation was very abundant and of a maximum virulence. (MM. Fiorentini and Luraschi appeared to us to have confounded vitality and virulence.)

No. 1 was immediately submitted to the X-rays every day during fifteen minutes, and for thirty-one days. No. 2 was submitted, but ten days afterwards, for twenty-two days and for fifteen minutes each time.

The control animals all died of acute tuberculosis, or sub-acute, in from fifteen to twenty days.

Guinea-pig No. 1 was sacrificed at the moment that it commenced to lose weight. No nodule existed at the point of inoculation ; in the abdominal cavity there was found a mass about the

\* As for this last guinea-pig, is it not just likely that the injection was subcutaneous and not intra-peritoneal, thus accounting for the lesions noted in the inguinal region, and the absence of all trace of lesion at the point of peritoneal inoculation.

size of a small nut, of caseous material ; the spleen was double in volume ; there were disseminated through the peritoneum numerous miliary nodules, having Koch's bacilli in them. One of the nodules was inoculated into a guinea-pig that twenty-three days afterwards still showed no lesion.

Guinea-pig No. 2 had, at the time of exposure to the rays (that is ten days after inoculation), a large nodule at the point of injection, and was somewhat emaciated. Subsequently the nodule disappeared, the weight of the animal increased, and the animal was finally sacrificed at the end of three months and a half. MM. Fiorentini and Luraschi wish to reserve for a future memoir the results of the autopsy.

The conclusion of their memoir is that their experiments entirely confirm the results of Lortet and Genoud. As with these last, they consider that it is logical to try, with the idea of cure, the application of the X-rays to man in cases of superficial tuberculosis, lupus and scrofulas.

By way of termination, let us recall that Müksam\* also submitted rabbits, tuberculized by way of the peritoneum, to the X-rays. All the rabbits succumbed to the progress of tuberculosis at variable lapses of time. Müksam admits that the X-rays, without action on generalized tuberculosis, may influence favorably local tuberculoses.

Again, recently Rodet and Bertin-Sans† observing on the existence of meningo-myelitis supervening in tuberculous guinea-pigs, as submitted to the X-rays, believe that with a proper gradation we might obtain favorable results.

Finally, there are results from these experiments that we have just related that if the local lesion has appeared to ameliorate during a certain time, all the animals have succumbed more or less rapidly to the progress of the tuberculosis. The obscure rays applied, so to speak, with a preventive view, have not stopped the evolution of the tuberculosis. This is the chief point, it is here that the principal objection is to be made to the too optimistic conclusions of MM. Lortet and Genoud, of Fiorentini and Luraschi.

\* Müksam, *Deuts. Zeit. f. Chir.*, XVII., p. 365, 1898.

† Rodet and Bertin Sans, *Congrès Montpellier*, April, 1898.

These experimenters look to the X-rays for the attenuation of the local lesion and for survival ; there are there, it appears, elements too uncertain to lean on. We know well what surprises there are in store for experiments on tuberculosis. The dose, or the virulence of the culture, the avenue of entrance of the bacillus, the soil, are so many elements which modify in the animals, as well as man, the evolution of the infection. Frequently we see the animals emaciate and succumb to the progress of the tuberculosis, when the tuberculous focus has cicatrized spontaneously. As to the survival, it is most variable, even in that most precious reactive that we possess, the guinea-pig. This animal, inoculated subcutaneously with tuberculous products may succumb in *six weeks* or *six months* after inoculation, and the final termination may be after *three weeks* or *three months*, when the injection has been intra-peritoneally.

The experiments that one of us (Teissier) has been able to follow this year, aided by M. Serbanesco, who, for close on to two years, has been occupied specially with studies on radiography in the service of Professor Potain, have borne on upwards of sixty animals. The animal of choice was the guinea-pig ; the method of inoculation, the quantity and the virulence of the culture employed, the time during which the animals were submitted to the X-rays were modified under conditions strictly marked out. The cultures of tuberculosis were inoculated either *subcutaneously*, into the *peritoneum*, into the *pleura*, or again into the *trachea* ; this last avenue was used in the rabbit.

All the animals under experiment were inoculated twenty-four or forty-eight hours before the first exposure to the rays. Among the control animals surviving, certain of them were, later on, exposed to the rays. It was thus possible for us to appreciate the *preventive* and *curative* value of the X-rays.

The weight of the animals under experiment, or the control animals, was nearly equal ; the conditions of nourishment and the conditions of life were identical in all.

In the first experiments the animals were tied down to boards ; it seemed to us preferable, the animals always struggling a great deal, to place them in boxes of thin wood or of cardboard, the size proportioned to the volume of the animal, in which they were

immobilized in their normal position. These boxes were lying on the ground. The animals were placed in the radioscopic field as we could judge by the Xoscope. They were consequently, on account of the distance at which they were placed from the tube (35 to 40 centimetres) out of the electrostatic field.

The apparatus used for the experiment was made up of a 40 centimetre Muret tube, excited by a powerful Ruhmkorff coil with a Radiguet interrupter giving with a current of a minimum intensity of 6 amperes, 45 centimetre sparks. The current was furnished by accumulators, giving from 20 to 30 volts, and of a capacity of 80 ampere hours.

The intensity of the current was always 6 amperes : the time of exposure to the rays varied from ten minutes to half an hour, to one hour every day, or every second day.

Under these experimental conditions we have not observed any trophic trouble in the animals, except that the animals submitted to the rays, and more particularly those exposed for a long period, were somewhat dejected, somnolent during the experiment and for a short time afterwards. The respiratory movements were also more frequent.

The following is a resume of each series of animals, divided after the method of inoculation, the effects observed from the point of view of *weight*, of *survival*, and of *lesions*.

#### *Subcutaneous Inoculations.*

##### SERIES "A."

*Quantity Injected.*—A half a cubic centimetre, diluted with sterilized water, of a two months' old culture of human tuberculosis, on glycerine bouillon (feeble virulence).

*Duration of Exposure.*—Ten minutes every second day ; the animals were fixed on boards.

*Number of Guinea-pigs.*—Six; three submitted, three control.

		Original weight.	8 days after.	15 days after.	Death.
<i>Weight:</i>	Guinea-pigs submitted.. No. 1.	550	560	500	460
"	" " " .. No. 2.	670	680	These two guinea-pigs died accidentally (destroyed by rats).	
"	" " " .. No. 3.	570	600		
"	Control guinea-pig .... No. 1.	620	640	570	410
"	" " " .... No. 2.	500	500	450	460
"	" " " .... No. 3.	680	720	680	470

*Survival.*—Guinea-pigs submitted : The remaining one twenty-five days.

Control guinea-pigs : No. 1, forty-nine days (one month and seven days after inoculation its weight increased, it was submitted to the X-rays during eighteen days) ; No. 2, thirty days ; No. 3, sixty-nine days.

*Lesions.*—Guinea-pig submitted : No. 1, tuberculous ulcer at point of inoculation ; tuberculous granulations in the liver and in the spleen ; the spleen is much augmented in volume ; nothing in the lungs. There was observed at different points on the intestine little areas of congestion or haemorrhage isolated or surrounded by tuberculous foci. The suprarenal capsule was very red.

Control guinea-pig : No. 1 (later on submitted), tuberculous ulcer with caseous accumulation at the points of inoculation ; spleen of medium volume ; tuberculosis of the right lung, grey infiltration marked.

Control guinea-pigs : Nos. 2 and 3, tuberculous ulcer at point of inoculation ; neighboring inguinal glands tuberculous ; tuberculous granulations in the liver and spleen ; spleen large ; tuberculous granulations in the lung in No. 3.

*Résumé.*—Emaciation more rapid ; the survival less for the two animals submitted: lesions apparently identical ; no effect either on the local lesion or on the general condition ; ecchymoses of the intestinal tract (guinea-pig submitted No. 1).

#### *Inoculations into the Peritoneum.*

##### SERIES "B."

*Quantity Injected.*—One-half a cubic centimetre of a dilution, in sterilized distilled water, of a two months' old culture of human tuberculosis, on glycerine bouillon (feeble virulence).

*Duration of Exposure.*—Ten minutes every two days. The animals were fixed on boards.

*Number of Guinea-pigs.*—Six; three submitted; three control.

			Original weight.	8 days after.	15 days after.	3 wks after.	Death.
<i>Weight:</i>	Guinea-pigs submitted ..	No. 1.	660	700	640	660	500
"	" "	.. No. 2.	660	720	670	650	580
"	" "	.. No. 3.	690	670	650	600	470
"	Control guinea-pigs ....	No. 1.	650	650	600	540	480
"	" "	.... No. 2.	790	870	850	860	530
"	" "	.... No. 3.	620	620	590	600	600

*Survival.*—Guinea-pigs submitted: No. 1, seventy-five days; No. 2, sacrificed after three months and a half; No. 3, fifty-four days.

Control guinea-pigs: No. 1, fifty-one days; No. 2, sixty-eight days; No. 3, twenty-seven days.

*Lesions.*—Guinea-pigs submitted: No. 1, large caseous mass at point of inoculation; fibro-caseous nodules in the thickened omentum; disseminated tuberculous granulations in the mesentery; spleen somewhat enlarged, a few granulations; small granulations in the liver and in the lungs.

Guinea-pig No. 2: A sowing of granulations and tuberculous nodules that had become fibrous on the thickened parietal peritoneum; liver fatty, filled with tuberculous granulations; omentum, a few granulations; spleen small, but tuberculous.

Guinea-pig No. 3: Large grey tuberculous granulations, very abundant, disseminated in the parietal peritoneum (anterior region); at this point the peritoneum is thickened and opalescent. The omentum much thickened and fibro-caseous; liver granulations numerous, very fine; spleen voluminous, a few granulations; at the apex of the left lung an area of intense congestion; a few granulations in the lung.

Control guinea-pigs: Lesions almost analogous in all three, in spite of the difference of survival; little or no fluid in the peritoneum; caseous mass at the point of inoculation, limited by adhesions; grey granulations disseminated on the parietal peritoneum, and on the mesentery; omentum thickened, fibro-caseous; spleen very large; granulations in liver and spleen; a few granulations in the lungs.

*Résumé.*—Survival greater for the submitted animals; variations in weight and lesions almost equivalent. The marked thickening of the peritoneum in two of the guinea-pigs submitted deserves notice.

SERIES "B<sup>1</sup>."

*Quantity Injected.*—A quarter of a cubic centimetre of a concentrated dilution, in sterilized distilled water, of a one-month-old culture of human tuberculosis, on glycerine bouillon (medium virulence).

*Duration of Exposure.*—One half hour every day; on several occasions only every two days.

*Number of Guinea-pigs.*—Six; three submitted, three control.

	Original weight.	10 days after.	20 days after	Death.
Weight: Guinea-pigs submitted..	No. 1.	750	680	600
" "	" .. No. 2.	640	570	530
" "	" .. No. 3.	520	500	490
" Control guinea-pigs....	No. 1.	720	770	700
" "	.... No. 2.	360	...	330
" "	.... No. 3.	770	710	680

*Survival.*—Guinea-pigs submitted: No. 1, twenty-two days; No. 2, twenty-four days; No. 3, sacrificed after one month and six days.

Control guinea-pig: No. 1, twenty-nine days; No. 2, nine days (already ill at time of inoculation); No. 3, twenty-one days.

*Lesions.*—Guinea-pigs submitted: Nos. 1 and 2, haemorrhagic fluid very abundant in the peritoneum; grey and yellow disseminated tuberculous granulations; omentum very thick with nodules, more caseous than fibrous; spleen increased in size; granulations in the liver; in the spleen; nothing in the lungs; a few ecchymoses in the intestinal tract. No. 3, discreet peritoneal granulations, voluminous spleen; clearly tubercular; granulations in the liver.

Control guinea-pigs: In No. 1, excepting for a slight clear peritoneal serosity, no ascites; large omentum, thickened, fibro-caseous; a few tuberculous granulations in the liver and spleen, this last not enlarged.

Guinea-pig No. 2, which weighed but 360 grammes and which succumbed nine days after, presented very marked tuberculous lesions, especially in the omentum.

*Résumé.*—Very little variation in the weights ; survival greater for one of the animals submitted ; intestinal ecchymoses, and especially haemorrhagic ascites for guinea-pigs 1 and 2 submitted ; lesions about identical.

SERIES "B<sup>2</sup>."

*Quantity Injected.*—A quarter of a cubic centimetre of a concentrated dilution, in sterilized distilled water, of a three months' old culture of human tuberculosis, of a tested virulence.

*Duration of Exposure.*—One hour every day ; on two occasions every two days.

*Number of Guinea-pigs.*—Six ; three submitted, three controls.

	Original weight.	8 days after.	16 days after.	Death.
Weight: Guinea-pigs submitted..	No. 1.	570	560	520
" "	" .. No. 2.	370	340	260
" "	" .. No. 3.	550	490	400
" Control guinea-pigs....	No. 1.	400	350	370
" "	.... No. 2.	470	500	490
" "	.... No. 3.	700	610	420

*Survival.*—Guinea-pigs submitted : No. 1, sacrificed after twenty-four days ; No. 2, sixteen days ; No. 3, thirteen days.

Control guinea-pigs : No. 1, sacrificed after twenty-four days ; Nos. 2 and 3, eighteen days.

*Lesions.*—Guinea-pigs submitted : No. 1, a few ecchymotic spots on the intestine ; a caseous mass at point of inoculation ; omentum slightly tuberculous ; liver and spleen clearly tubercular (this last voluminous).

No. 2, No ascites ; disseminated tuberculous granulations on the parietal and visceral peritoneum ; spleen small ; a few granulations in the liver. Nothing else.

No. 3, haemorrhagic fluid in the peritoneum ; haemorrhages along the course of the intestine, and mesentery ; large nodules, more fibrous than caseous, in the omentum ; spleen normal.

Control guinea-pigs : Nos. 1 and 2, no fluid in the peritoneum ; discreet tuberculous granulations in the peritoneum ; granulations in the liver and spleen, this last voluminous ; nothing in the lungs.

No. 3, Clear fluid, small in quantity, in the peritoneum; liver tuberculous and fatty; spleen small size, not tuberculous; omentum much infiltrated; grey and yellow granulations in the chin area. Nothing else.

*Résumé.*—Variations about equal as to weight; survival less in average for the submitted animals; lesions comparable; in most of the animals submitted, ecchymosis in the intestine and haemorrhagic ascites.

### *Inoculations into the Pleura (Right Pleura).*

#### SERIES "C."

*Quantity Injected.*—One quarter of a cubic centimetre of a concentrated dilution in sterilized distilled water, of a culture of human tuberculosis, one month old (verified of medium virulence).

*Duration of Exposure.*—One half-hour every day; on several occasions only every two days (at the same time as series B').

*Number of Guinea-pigs.*—Six; three submitted, three controls.

		Original weight.	8 days after.	20 days after.	Death.
Weight:	Guinea-pigs submitted..	No. 1.	610	550	500
"	"	.. No. 2.	770	720	560
"	"	.. No. 3.	440	410	310
"	Control guinea-pigs....	No. 1.	540	490	320
"	"	.... No. 2.	620	620	490
"	"	.... No. 3.	580	660	480

*Survival.*—Guinea-pigs submitted: No. 1, twenty-two days; No. 2, sixteen days; No. 3, fifteen days.

Control guinea-pigs: No. 1, twenty-one days; No. 2, sacrificed after one month and six days; No. 3, thirteen days.

*Lesions.*—Guinea-pigs submitted: No. 1, almost total adhesion and much thickening of the right pleura; between the thickened layers, points of tuberculous caseation; lung much retracted; adhesions of the parietal pericardium at certain points; raising of the diaphragm; retraction of the thorax.

The thickening of the pleura most marked, attained a thickness at certain places of 3 millimetres; nothing in the other lung, and nothing in the other viscera.

No. 2. Almost complete obliteration and great thickening of the right pleura ; adhesions to the external layer of the pericardium ; lung much retracted ; no adhesions in the left pleura ; a few granulations on the pleural surface of the left lung ; some raising of the diaphragm.

No. 3. At the point of inoculation a very vascular nodule on the right parietal pleura enclosing a fibro-caseous mass ; marked adhesions and thickening at this point ; a few scattered adhesions in the rest of the pleura ; a few granulations ; nothing in the other lung, nor in the other viscera.

Control guinea-pigs : No. 1, fibro-caseous nodule at the point of inoculation on the right parietal pleura ; adhesion of the lung at this point ; a marked congestion of the lung at this point ; the lung is not retracted ; a few loose false membranes at the posterior border.

No. 2. Pleura absolutely smooth ; a small fibro-caseous encysted mass in the parietal pleura ; lungs normal ; a few granulations in the liver and in the spleen.

No. 3. A small quantity of haemorrhagic fluid in the right pleura, probably a small puncture of the lung ; loose adhesions. Nothing else.

*Résumé.*—Variations in weight more noticeable in the animals submitted ; survival less on an average in these last ; nature and intensity of the lesions essentially different. The thickening, the extent of the pleural obliteration masking the tuberculous lesion, was truly remarkable in the animals submitted.

#### SERIES "C<sup>1</sup>."

*Quantity Injected.*—Quarter of a cubic centimetre of a concentrated dilution, in sterilized distilled water, from a culture of verified virulence of human tuberculosis, one month old.

*Duration of Exposure.*—One hour every day, except on two occasions, then every two days.

*Number of Guinea-pigs.*—Six ; three submitted, three controls.

	Original weight.	8 days after.	16 days after.	Death.
<i>Weight:</i> Guinea-pigs submitted .. No. 1.	580	600	460	340
“ “ “ .. No. 2.	610	480	..	400
“ “ “ .. No. 3.	370	280	..	250
“ Control guinea-pigs .... No. 1.	580	580	570	560
“ “ “ .... No. 2.	600	430	400	330
“ “ “ .... No. 3.	660	..	..	600

*Survival.*—Guinea-pigs submitted : No. 1, twenty-one days ; No. 2, eleven days ; No. 3, ten days.

Control guinea-pigs : No. 1, sacrificed twenty-four days after ; No. 2, death three days after inoculation, tear of the lung ; clot in the pleura.

No. 3, faulty operation ; inoculation did not enter the pleura, but under the skin.

*Lesions.*—Guinea-pigs submitted : No. 1, caseous mass underneath the skin ; a few granulations in the peritoneum, and in the liver, the spleen (the latter very voluminous). Nothing in the pleura or lungs. (This guinea-pig might be included in the series of subcutaneous inoculations).

No. 2. Complete obliteration and great thickening of the right pleura, with yellow granulations scattered about ; membranes at certain points haemorrhagic ; left lung much retracted. Obliteration of the pericardium ; a small tuberculous nodule in the right pleura.

No. 3. Total adhesions of the right pleura ; the parietal layer of the pericardium is very thick ; tuberculous granulations between the adhesions ; lung retracted and congested. Nothing else.

Control guinea-pigs : No. 1, scarcely any lesion, no adhesion of the right pleura ; lung normal ; in the second intercostal space a small encysted tuberculous nodule ; a few granulations in the liver and spleen.

No. 2. A few loose adhesions, posterior border of the right lung ; a cicatrix with caseous areas at the seat of inoculation ; lung normal in volume ; spleen large. No other lesion.

No. 3. Accidental death from tear of the lung ; pleural haemorrhage ; voluminous clot at the base.

*Résumé*—Short survival of the animals submitted. Death more rapid than other series C, since the controls had to be sacrificed.

Here again complete obliteration, of the most marked kind, of the normal pleura in the animal submitted ; raising of the diaphragm ; the minimum of lesions on the contrary in the control animals.

### *Intra-tracheal Inoculations.*

#### SERIES "D."

*Method of Operation.*—From two to three drops of a dilution, in sterilized distilled water, of a one-month-old culture of human tuberculosis, in glycerine bouillon (verified virulence).

After an aseptic incision of the skin of the neck a direct injection into the trachea with a Pravaz needle ; suture of the wound, dressing with cotton collodion.

*Duration of Exposure.*—Every day, and every two days, during six minutes, for one hour.

*Number of Rabbits.*—Twelve, of which two series were made. (a) Six : three submitted, three controls. (b) Six : three submitted variable times after inoculation, three controls.

But the day following the inoculation an infectious disease attacked the cages, killing five of the rabbits, and at the same time ten guinea-pigs.

Of the seven rabbits remaining, four were put in a first series "D," and three in another "D.<sup>1</sup>"

SERIES "D."—Nos. 1 and 2 were submitted to the X-rays ten days after inoculation, at first six minutes, then one hour (one month and five days after the infection).

Nos. 3 and 4.—Control rabbits.

	Original Weight.	15 days after.	26 days after.	36 days after.	Death.
<i>Weight : Rabbits submitted</i>					
No. 1.....	2,100	1,800	1,800	1,700	1,550
No. 2.....	2,220	2,270	2,250	2,170	1,800
<i>" Control rabbits</i>					
No. 3.....	2,000	2,270	2,200	2,050	1,450
No. 4.....	1,900	1,930	1,750	1,520	1,200

*Survival.*—Rabbits submitted : No. 1, thirty-nine days ; No. 2, sacrificed two month and thirteen days after inoculation.

Control rabbits : No. 3, thirty-nine days ; No. 4, sacrificed two months and thirteen days after inoculation.

*Lesions.*—Rabbits submitted : No. 1, trachea very red throughout its whole extent ; no tuberculous granulations, and no ulceration.

At the upper and lower part of the lower lobe of the right lung and left lung, grey and yellow granulations. Granulations exist equally at the posterior borders of both lungs ; a few granulations in the liver ; spleen normal.

No. 2, trachea very red, much congested ; a few disseminated granulations in the two lungs ; a few granulations in the liver.

Control rabbits : No. 1, operative failure ; inoculation was not made into the trachea ; there existed, in the retro-tracheal space, a large caseous abscess ; nothing in the lung ; a few granulations in the liver.

No. 2, a few small granulations in the right lung ; trachea much congested. Nothing else.

*Résumé.*—Survival comparable : Variations in weight exactly alike ; as to the lesions, very little marked in both cases.

SERIES "D".—*Duration of Exposure.*—One hour every day.

Number of Rabbits.—Two submitted, and one control.

	Original Weight.	15 days after.	26 days after.	49 days after.	Death.
<b>Weight :</b> Rabbits submitted					
No. 1.....	2,150	2,180	2,200	1,750	1,700
No. 2.....	1,930	2,020	2,070	1,730	1,620
" Control rabbit					
No. 3.....	2,350	2,130	2,050	1,600	1,600

*Survival.*—Rabbits submitted : No. 1, fifty-five days ; No. 2, sacrificed two months and thirteen days after inoculation.

Control rabbit, fifty-five days.

*Lesions.*—Rabbits submitted : No. 1, trachea much congested ; a few granulations in the lungs ; spleen small ; a few granulations in the liver.

No. 2, trachea much congested ; a few granulations in the lung and in the liver.

Control rabbit : Trachea much congested ; pus abundant in the bronchi ; suppurating tuberculous infection of the middle lobe and of the upper portion of the inferior lobe of the right lung ; emphysema of the apex ; a few granulations in the liver.

*Résumé.*—Survival and variations in weight analogous; same lesions as the preceding series, only the control rabbit seemed to be attacked by a more accentuated tuberculous bronchitis.

We make of the rest all reserve, having regard to the small number of animals and to the failure of operation, on the absolute value of these experiments which we shall pursue farther.

We may then conclude from these researches: that the animals (guinea-pigs and rabbits) tubercularized by different avenues, and submitted during periods of time more or less prolonged to the obscure rays, present variations in weight of a greater or less degree, or of survival very like that in the control animals; that the microscopic aspect, the extent of and the gravity of the tuberculous lesions is in the two cases practically the same.

The greater part of the animals succumbed spontaneously to the tuberculosis without the local lesions being modified, in spite of the existence at times of a process in appearance curative, without the evolution and the generalization of the infection, showing an indisputable arrest by these rays. And still, we repeat it, the rays were for the most part applied in a preventative way before the tissues, not yet altered, and in the best condition to resist the infection; in one word, conditions which could not be realized in human pathology.

Is it to be said always that these obscure rays have not exercised any influence on the animals under experiment?

We have spoken above of the physiological effects that we have observed; we have pointed out, in relating our experiences, the few pathological phenomena met with exclusively in the animals submitted. It would behoove us to know now, if these phenomena can be considered as favorable, or as the result of a salutary reaction. They can hardly be, it seems, anything but pathogenic these ecchymoses, these hemorrhages met with along the intestinal tract, the hemorrhagic ascites existing in the animals that had been inoculated peritoneally, the thickening more or less marked of the parietal peritoneum, co-incident with tuberculous lesions as intense, if not more so, than those observed in the control animals. But what must we think of this pleural sclerosis so extensive, of this total obliteration of the inoculated pleura, existing exclusively in the submitted animals, a sclerosis approaching that observed by Destot

on the cutaneous surface of guinea-pigs submitted to the rays, to that so marked seen at the autopsy of the little patient treated in the service of Professor Potain. Without doubt the sclerosis is a mode of spontaneous cure for tuberculous lesions ; it is a favorable mode of termination for the malady *when it is not too extensive*; and that which was produced in the control guinea-pigs inoculated into the pleura, and which ended in an encystment for the localization of the tuberculous lesions, may be considered as such. But it is not thus with this clear cut process, striking rapidly the whole extent of the pleural surface, retracting the lung determining a raising of the diaphragm and flattening of the thorax, and that without limiting the tuberculous lesion that was started ; on the contrary, giving rise to numerous new points.

We shall content ourselves for the moment with pointing out these facts without attempting to discover whether we should attribute them exclusively to the X-rays or whether we should attribute a part of it to the action of the electrostatic field, we may recall only that the distance at which our animals were placed from the radiant tube diminished, probably suppressed, the action of this electrostatic field, and that for this reason, without doubt, we have not observed in our animals any trophic trouble or any irritating action at the seat of the local lesion.

All these facts, aside from their pathogenic interpretation, show, to our idea, how much more prudent it would have been to hesitate before concluding on the favorable influence of the rays applied to the tuberculous organism.

The experimental pathological results bid us hesitate and plead, so far as the present, against the application of the X-rays to the treatment of human tuberculosis. There is more, the physiological effects observed in the animals submitted to these radiations, prove that radiotherapy is not only illusionary on the subject of tuberculosis, but it runs contrary to the rational ideas of anti-tubercular treatment.

We know to-day that the respiratory movements are augmented in frequency, that the intra-vascular pressure is diminished, that the nutrition of the tissue may be altered as a consequence of the diminution in exchange in the cellular fluids.\* Crolas has shown

us that there is an increase in the elimination of uric acid and of salts ; Lecercle,\* that the elimination of phosphates was notably increased. Tarchanoff has pointed out a phenomena of nervous inhibition in the frog. Rodet and Bertin-Sans have shown medullary lesions in the guinea-pig, and finally ; we ourselves have observed a special languor in the animals submitted.

Are not these, then, serious contra-indications to the application of the X-rays to the tuberculous in whom it behooves to diminish rather than increase the respiratory movements, to raise the arterial pressure, already too low, to inhibit elimination, already too great, of phosphates ?

And do not all these united suffice to put us on our guard against the hopes raised by past insufficient experiments ?

#### ACTION OF THE X-RAYS ON CLINICAL TUBERCULOUS AFFECTIONS.

To get a thorough view of the effects of the X-rays on clinical tuberculosis, it appears to me necessary to divide as follows :

1st. Action of the X-rays on tuberculous manifestations of the skin ;

2nd. Action of the X-rays on tuberculous lesions of the joints ;

3rd. Action of the X-rays on pulmonary tuberculous lesions.

This division is the more necessary since the researches published up to the present bear on these three manifestations of tuberculosis, and that the conclusions at which these researches arrive are different, according as the workers report on one or other of these manifestations.

**ACTION OF THE X-RAYS ON TUBERCULOUS MANIFESTATIONS ON THE SKIN.**—We have seen that X-rays, produced as is usual by a powerful Ruhmkorff coil and a Crooke's tube, had a certain action on the nutrition of the skin ; this action is proved by accidents a hundred times observed. It could be foreseen, that on the skin attacked by various lesions, and especially covered with plaques and erosions, that the action of these rays would be equally manifest ; it is this that a great number of authors observed.

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\* Lecercle, *Acad. des sciences*, 1897.

Among the works published on this subject, the most exact and the most convincing is that by M. Albers Schoenberg, entitled "The Therapeutic Use of the X-rays in the Treatment of Lupus."<sup>\*</sup>

The author, who gives the photographs of his patients before and after treatment, has applied the treatment himself to two cases of lupus of the face treated, at first, by the ordinary method; that is to say, by curetting, iodoform, actual cautery, nitric acid, tuberculin, etc., without any appreciable result; the two patients were submitted to the X-rays, and all parts of the face not attacked by the disease were protected by a tin mask; a cap of the same metal covered the scalp so as to avoid epilation, so often recorded as occurring from the X-rays. The tube was placed at 25 centimetres only from the face, and the coil absorbed 100 watts to excite the tube used. The duration of exposure was from twenty minutes to half an hour. After seventeen days of treatment for one of the cases, the dermatitis had generalized itself to the whole surface, and from this moment the cure progressively came about. Six months after it was complete in both cases.

This work is a good example of the method of procedure and the results that it is possible to obtain by the X-rays in lupus manifestations.

The later works confirm, at least in part, these results. We might mention those of Schiff and Freund<sup>†</sup> who obtained excellent results on lupus and saw torpid ulcerations transform into a cutaneous surface; they observed also a diminution in volume of the neighboring glands.

In a case unpublished, observed by one of us (Teissier), a child of thirteen years attacked by lupus on the left leg over a surface of 6 to 7 centimetres, was submitted by M. Serbanesco to the X-rays produced by a Muret tube, excited by a coil giving a 45 centimetre spark; the tube was placed at a distance of 40 centimetres from the cutaneous surface. Thirty seances were made with numerous interruptions caused by the state of the ulcer (very acute dermatitis) or on account of the lack of electricity in the accumulators. During the seance the patient experienced prickings at the seat of

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<sup>\*</sup> *Archiv. d'électr. méd.*, January 15th, 1898.

<sup>†</sup> *Semaine méd.*, January 28th, 1898.

the ulcer ; after the sixteenth seance the very thick crusts which covered the lesions fell off and the epidermis appeared to grow in at the periphery with a normal appearance. The lupus nodules seemed to separate, and the ulcer had a very favorable appearance, when the patient was obliged to leave the service (service of M. Potain, at La Charité). She came back several months afterwards ; the ulcer had again increased in size, suppurated, and had formed crusts as thick as before. New seances produced the same effect ; falling off of the crusts, acute dermatitis, tumefaction about the lupus area, and the appearance of an extended ulceration, with sharply cut edges. We suspended the treatment, and after taking it up again we observe that the ulcer is still painful, that it is granulated near the centre and that the lupus nodules have certainly diminished in size.

These results should be compared, it seems to us, to those obtained in the treatment of lupus by ordinary luminous rays, long ago observed. Recently, Niels and Finsen\* have treated by luminous rays, produced from an electric arc, cases of lupus, and have obtained good results. With an arc of 80 amperes, quartz lenses, which would let pass ultra-violet rays, and a screen formed by a ammoniacal solution of a copper salt which arrested the long wave rays, they treated very limited areas (of from 1 to 3 square centimetres of surface) and obtained, after a more or less extended time, an intense rubefaction.

We must evidently include these results with those obtained with the X-rays ; in fact, the active agent seems to be the same in the two cases if we think that, with the majority of physicians, the X-rays, may be placed among the ethereal rays, differing from luminous rays, but in a length of order extremely small ; they would be *ultra ultra-violet rays*.

On the other hand, it is not merely a theoretical view, for Kummel has been able to point out from a comparative experiment,† in the treatment of lupus with the X-rays and a concentrated light, that there was in both cases, the same useful action.

In conclusion, the X-rays act on the lupus manifestations by producing, like luminous rays in radiotherapy, a dermatitis, more

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\* *Archiv. d'électr. méd.*, January, 1898.

† *Soc. allemande de chir.*, Berlin, April 15th and 16th, 1898.

or less intense, and it is by this reactionary inflammation that the effects reported are due. The difficulty is not to produce a dermatitis, followed by amelioration or even cure, at least temporary, but to limit this dermatitis in intensity and extent. We may remember especially the long period of incubation of these dermatites, an incubation which might extend three weeks, and we should not rely on a default of immediate reaction, to make too long an exposure and too numerous applications.

We would conclude, then, that in cases of cutaneous tuberculous manifestations, and particularly in the case of lupus, the action of the X-rays, as has just been related, is certain, and that they can produce, in certain cases, an efficacious dermatitis, bringing about an amelioration or a cure, at least temporary, of the affection. This dermatitis is difficult to limit; it is of the same nature as that provoked by exposure to rays of short wave length.

**ACTION OF THE X-RAYS ON TUBERCULOUS LESIONS OF JOINTS.—** The action of the X-rays on the tubercular lesions of joints is much more disputable. The works on this subject are more rare, and amongst those published, we might cite as before, a typical case, that by M. E. Kirmisson, entitled : "Tuberculous Osteoarthritis of the wrist, cured by the use of the Roentgen Rays, followed by Elastic Compression."\* This case was that of a young man, seventeen years of age, having a tuberculous arthritis of the left wrist, with an enormous development of fungosities ; the circumference of the wrist measured 23 centimetres ; numerous fistulae existed, as well on the dorsal surface as on the palmar surface of the wrist, the hand dropped and the fingers were inert. From May 15th, we commenced to apply the X-rays to the wrist for ten minutes each day ; under this influence we got a rapid diminution in volume of the fungosities and a complete cicatrization of the fistulae on the dorsal surface. The treatment by exposure to the X-Rays was continued during two and one-half months, until the end of July. When M. Kirmisson came back to his clinic, in December, the patient, for all much better, was not yet cured. The author then applied elastic compression, and under this a rapid cure was obtained.

During the discussion at the Society of Surgery which followed

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\* *Bull. et mém. de la Soc. de chir. de Paris*, January and February, 1898.

this presentation, M. Bazy reported that he also had tried, on a tibio-tarsal osteo-arthritis, the action of the X-rays, but that the result, without having been bad, was far from being perfect.

A fact was drawn from the complete discussion of M. Kirmisson's case. It was that the greater number of surgeons who examined this case insisted on the necessity of conservative treatment and its efficaciousness, more than on the action of the X-rays proper. It is then permitted to us to think that they attributed to the conservative treatment the greater part of the cure of the case of M. Kirmisson and the amelioration of the case of M. Bazy.

In November, 1897, de Lancastre\* published the cure of a suppurating osteo-periostitis by the application of the X-rays. It seems clear that in this case there was also a tuberculous manifestation, for this osteo-periostitis was of two years' standing, and was treated without result by the sclerogenic method and presented numerous fistulae in the neighborhood of the lesion. It was while trying to make a radiograph of the forearm of the patient that the author obtained an after inflammation of the region, which seemed to him favorable, and which he attempted to renew by successive exposures. The seances were held for three days and lasted twenty minutes ; the author reports a complete cessation of the purulent discharge, after a few seances, and a progression towards cure of the ostitis.

Since the slow results of this treatment were not indicated in this last case, we may include it with those of MM. Kirmisson and Bazy, and ask ourselves if, at the same time that a long immobilization of the limb necessitated by the treatment, the revulsion produced on the skin in the region of the lesion and also in the region of the fistulous orifices, has had a favorable influence on the progress of the disease.

Let us cite again the case of M. Saintont, in which a tuberculous arthritis of the left wrist with fistulae was immobilized by plaster splint exposed to the X-rays ; there was no ulceration of the skin, for all that the tube was but 20 centimetres from the hand; amelioration was marked.

As conclusion, if we have obtained good results in the treat-

\* *Revista Portugueza de méd. et cir. prat.*, No. 25, p. 352, November, 1897.

† *Journ. de radiogr.*, February, 1898.

ment of tubercular arthritis, we cannot, in the case published, separate the action of the X-rays from the conservative treatment and especially the immobilization. The only symptom which appertains to the X-rays in these applications would be that of an inflammation of the region after the applications ; it is then for us to find out if it has a good effect; in all the cases it could have been replaced by other methods as efficacious and, for the present, more under control.

**ACTION OF THE X-RAYS ON TUBERCULOUS PULMONARY LESIONS.**  
—This is the most important point of all those which have been given us to treat in this report, and we understand very well that if the X-rays were capable to arrest, to retard, or to modify at all the evolution of pulmonary tuberculosis, our gratitude, already so great, to Professor Roentgen would be such that we should put him in the first rank of the benefactors of humanity. Unfortunately this favorable influence of the X-rays on the evolution of tuberculosis is far from being demonstrated to-day; we can judge of this from what follows.

We shall take, as before, a typical case, and of the kind, the first case well observed that has been published, that of MM. Rendu and du Castel.\* This is a case of a young man twenty years of age, attacked by an acute affection which developed as a pneumonia of the middle lobe of the right lung ; as the symptoms modified themselves the general state became more grave, signs of breaking down of the pulmonary block succeeded to those of grey hepatization, fever became continuous, two accesses a day. It is at that time that the seances of exposure to the Roentgen rays were undertaken ; they were done every day and lasted five minutes. From the third day a favorable change was produced and the patient had no more fever ; from this time the amelioration progressed constantly, the patient was able to be moved to the country ; his strength and weight came back and the local manifestations in the lung kept up with the progress of the general health.

During the treatment, lesions of the skin, which took three weeks to cure, were produced.

The authors, who seemed to us to have observed without any preconceived idea, believed the part of the Roentgen rays to pre-

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\* *Soc. méd. des hôpits.*, January 15th, 1897. *Presse méd.*, January 16th, 1897.

ponderate in the amelioration obtained, and they attempted to explain this amelioration by an arrest of the vitality and the multiplication of the germs struck by the rays, the chemical action of which seemed to be undeniable. On the other hand, it seemed wise for them to reserve all conclusions, because the precise nature of the sickness with which their patient was attacked was not demonstrated for them to a certainty. From an oral communication by M. du Castel, made recently to one of us, we know that these reservations were not useless, because since then the patient has become phthisical ; he is actually, at the present time, in the last stage of the cachexia. M. du Castel thinks that at the time of treatment there was rather an acute infection superadded to the tuberculosis.

We find, on the other hand, that the communication made by these authors to the *Société medicale des hôpitaux*, that M. du Castel says he knew that, in spite of the repeated experiment at several seances after the first published success, he always had negative results ; the Roentgen rays showed themselves efficacious but once.

Since the publication of the work of MM. Rendu and Du Castel, a number of authors have experimented by this method, and we well understand how interesting it is to elucidate their value.

In the case published by M. Revillet, of Cannes,\* it referred to a case of pulmonary and laryngeal tuberculosis treated by the X-rays applied by Dr. V. Morel. The method of experiment was that which we already know. As to the patient, he was a young man eighteen years of age, the son of a father who died of tuberculosis and himself inflicted with laryngeal and pulmonary tuberculosis. From the beginning of the treatment the fever diminished in intensity and the temperature fell to between 37° and 38°, instead of 40°. And again, as for favorable symptoms, there was a regaining of appetite and the laryngeal state was rather improved, but the auscultatory and percussion signs remained the same.

As in M. du Castel's case, and many others that we shall have to examine, a phlyctenular erythema appeared several days after the first seance. But, curiously, at the same time that this erythema showed itself at the anterior portion of the thorax, the part struck by the rays, a similar erythema, less violent, appeared

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\* *Rev. de tuberculose*, April, 1897.

on the dorsal surface of the thorax, as though at the point of exit of the X-rays. The rays had not at any time struck directly this affected part, still we believe this unique fact merits recording.

As to the termination of the illness in the patient of M. Reveillet, it was rapid; two months after the commencement of the treatment he was seized with violent pain in the side, with sanguinolent expectoration; the general state very grave, temperature  $40^{\circ}5$ , and died three days afterwards from an attack of caseous pneumonia.

We note in this case, as in that of MM. Rendu and du Castel, the appearance of a phlyctenular erythema, the antifebrile action produced by the X-rays, and a secondary phenomena observed also by a number of authors; the patients slept during their exposure to the X-rays.

The case of MM. Chanteloube, Descomps and Roulliès,\* was twenty-one years of age, clearly tubercular on both sides, with a purulent focus at the right apex; numerous Koch's bacilli were found in the sputa. A rapid falling off of the general health, and fever almost continuous for two months. It was on February 7th, 1897 that they commenced to apply the X-rays *at his home*, by means of an appropriate apparatus (coil giving a 22 centimetre spark). From the beginning of the use of this new therapeutic agent, done to the exclusion of all other medication, there appeared a distinct crisis at the eighth application manifested by a notable falling of the temperature. As to the progress of the disease it was not affected, and there was noted but a slight amelioration. After this twenty-one seances were again held, two seances a day, and there was noted a drying of both lungs, diminution of the cough and expectoration, and almost complete disappearance of Koch's bacilli. The phlyctenules appeared at this time, the temperature remained elevated and the general state without any modification. And again, the authors following out the evolution of the illness, after the employment of the X-rays, record the persistence of the good effects produced, the diminution of the cough, the disappearance of the diarrhea, and the improvement of the physical and mental strength. But the illness progressed continuously, and the

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\* *Archiv. d'électr. méd.*, p. 180, May, 1897.

temperature is the proof of it, which remained always elevated (38°5 at night).

For all that the authors reported at that time a manifest amelioration in the state of the lungs, the continuation of observation, that we know of through a communication of Dr. Roulliès, did not confirm these first results, and the patient succumbed to his affection.

In M. Ausset's case,\* a girl of seven years of age, attacked by an advanced tuberculosis of both lungs, with voluminous mesenteric glands, the treatment was used from July 7th to 27th, and the result was, cessation of abdominal pains and diminution of the diarrhoea. But this amelioration, very temporary, disappeared as soon as the application of the X-rays was discontinued, and the patient soon afterwards succumbed.

In the work published by one of us (Bergonié), in collaboration with M. Mongour, physician of the hospitals of Bordeaux†, five cases of tuberculosis were treated by the X-rays by means of the apparatus already spoken of, and with an intensity of rays defined by their photographic activity. In these five cases were two cases of acute tuberculosis ; the other three were cases of chronic pulmonary tuberculosis. All the patients were carefully examined before their treatment ; their lesions were carefully mapped out ; the Koch's bacilli were found to exist in all ; some were put down before and some after the treatment.

The conclusions at which we arrived in these five observations, collected with as much impartiality as was possible, were as follows :

1st. In two cases of acute tuberculosis observed in patients whose organic falling off was helped by alcoholism and privations, the action of the X-rays was absolutely *nil*, as well on the local state as on the general.

2nd. The three cases of chronic pulmonary tuberculosis gave us the following results : First case, result *nil*. Second case, amelioration of the general state ; return of strength and appetite ; no modification of the local condition. Third case, amelioration

\* *Journ. de clin. et de thérapeut. infantiles*, 1897.

† *Archiv. d'électr. méd.* p. 309, August 15th, 1897.

of the local and general condition during a month and a half; a new aggravation, due probably to grave dyspeptic troubles.

In the three last cases the X-rays did not have any favorable action ; the pulmonary tuberculosis followed its course without there being any aggravation of the tuberculosis attributable to the treatment.

Finally, Koch's bacilli did not seem to be modified either in number or in form under the action of the X-rays.

The last work which we shall cite in this memoir, not to lengthen it out too much, is on two unpublished observations by one of us (Teissier), cases of tuberculosis treated by the X-rays in the service of Professor Potain by M. Serbanesco. In the first case, a young girl twenty-one years of age, attacked by tuberculosis in the second degree, of slow evolution, with a slight pleural accumulation. She was submitted to the X-rays during fifteen daily seances, from ten to twenty minutes each. After the seventh seance the phlyctenules showed themselves in the region of entrance of the rays. After the fifteenth seance, and without any appreciable stethoscopic modification being noted at the right apex from the tubercular point of view, there came on suddenly a pain in the side with signs of broncho-pneumonia and sanguinolent expectoration. We stopped the applications, but tuberculosis continued, and six weeks afterwards the patient died. At the autopsy we found many cavities; around the cavities caseous pneumonia, and at certain points interstitial pneumonia; the inferior lobe of the lung treated is crowded with miliary tubercles with red hepatisation. We found also an obliteration of the right pleura with much thickening, except on the internal surface of the lung. The apex of the superior lobe and the posterior border of the three lobes were adherent to the parietal pleura.

In the second case, which commenced in 1896, a young man of twenty-one years, attacked by an apyretic tuberculosis of the second degree, with induration of both apices and tuberculosis of the cervical glands ; twenty-two seances in all were made, interrupted on several occasions. A minute analysis of the stethoscopic phenomena, of the temperature and of the arterial pressure, before and after the seance, could not show any special modification, except that the glands in the cervical region, forming a

voluminous mass, are smaller and more isolated ; the weight had rather diminished.

#### CONCLUSION.

The conclusion to draw from these facts, from the point of view of the action of the X-rays on the lesions of pulmonary tuberculosis, did not seem to us difficult ; because, if the authors had been able to observe in the most fortunate cases certain favorable symptoms, as, for instance, the diminution of the fever, sometimes an amelioration of the general condition, but more rarely a modification of the local condition, these fortunate symptoms have not persisted, the disease has followed its course, and the end does not seem to have been retarded.

In a few of the cases, as, for instance, those of M. Revillet and of M. Teissier, we note acute accessions of pneumonia which, without being able to attribute distinctly to the action of the X-rays, have been too simultaneous not to give rise to some doubt as to its cause. Again, in the case of MM. Bergonié and Mongour, dyspeptic troubles, more severe than before, coincided with an accentuation of the treatment ; and for all that we cannot put it to the account of the applications made, the authors had on account of them to suspend their employment.

In conclusion, the definite results, well observed, of the action of the X-rays on pulmonary tuberculosis are nearly all negative. Not only has the disease not been cured, but, again, its evolution has not been stopped nor retarded ; and we must until now consider, as demonstrated by the works that have already appeared, that if this action is not dangerous, at least its *therapeutic efficiency is nil.*

#### GENERAL CONCLUSIONS.

The general conclusions of this report will be the resume of those which we have drawn after the account of each one of these divisions.

It is impossible not to recognize the action of the X-rays on living organisms. Outside of the experiments done on animals and on man this action has been demonstrated by very exact work done on

vegetables ; among others, recently by MM. Maldiney and Thouvenin.\* The experiments of M. Bordier on the influence of the X-rays on the phenomenon of osmosis† are equally interesting to take into account in this regard.

That this action is due to a mechanism of which we do not know the nature, or, as has been written,‡ to the *ionisation* of certain chemical compounds impregnating the tissues, ionisation followed by a secondary action on the cellular protoplasm or on the bacilli, similar to that determined by electrolysis, the action seems to us indisputable.

As to drawing inference from this action yet so little known, not only in its essence, but again in its physiological domain, that is assuredly premature. Again, could we from the works published, that we have been able to examine, and in the condition in which to-day the applications of the X-rays are made, could we lay down the following conclusions ?

**CONCLUSIONS BEARING ON EXPERIMENTAL DATA.**—The X-rays exercise no influence on the morphology, the vitality, or the virulence of the tubercle bacillus. The physiological or pathological effects observed on healthy animals or tuberculized ones submitted to the X-rays, plead against the application of radiotherapy to tuberculosis.

The action of the X-rays on experimental tubercular lesions in the guinea-pig and the rabbit may be considered as *nil*. The effects of the amelioration of the local lesion or of the survival noted in animals submitted is observed as frequently in the control animals.

The attractive reactionary inflammation with certain of the tuberculized animals submitted to the rays, the production of parietal haemorrhages of the intestine or the formation of a sclerotic process which became veritably excessive in the intra-pleural inoculation of the tuberculosis, cannot be considered under the actual conditions of experiment and whatever might be the cause, as a salutary reaction. In spite of the pleural obliteration the tuber-

\**De l'influence des rayons X sur la germination (C. R. de l'Acad. des sciences, February 14th, 1898).*

†*C. R. de l'Acad. des sciences, February 21st, 1890.*

‡Ch. E. Guillaume, *Les rayons X et la dissociation (Rev. gén. des sciences, July 15th, 1897).*

culous lesions were actually more extended and more diffused in the animals submitted.

**CONCLUSIONS BEARING ON CLINICAL DATA.**—The action of the X-rays on the *tuberculous lesions of the skin* may produce in certain cases a dermatitis leading to either amelioration or to a cure, at least temporary, of the affection. But this dermatitis may be produced by other means, and moreover it is difficult to graduate.

The action of the X-rays on the *tubercular lesions of joints* is difficult to separate in the cases published from the results by immobilization, which always accompanied it. The reactionary inflammation, due certainly to the X-rays, that has been noted in these cases, present the same disadvantages as in the preceding case.

Finally, the action of the X-rays on *pulmonary tuberculous lesions*, if it has seemed in a few of the cases to give temporary favorable results, has never led to a positive or durable favorable modification. We believe even that we should affirm that if, thanks to the unknown which reigns still with reference to the action of the X-rays in biology, it is laudable and, at the same time, necessary to continue the experiments undertaken, it behooves to be extremely reserved in the employment of the X-rays in human therapeutics.

## Two Years' Practice with the Roentgen Rays.

By G. GAUTIER M.D., and J. LARAT, M.D., of Paris, France.

The numerous radiosopes and radiographs we have had the occasion to make since Roentgen's discovery, and most of which have been done at the Hospital for Sick children, allow us to add some of our personal remarks from the technical point of view, as well as with regard to the applications, to the many articles already published everywhere.

The electric centre which we use is a bobbin giving 40 amperes of sparks. The interrupter is rotative, with a metal point diving into a basin filled with mercury (modèle Ducretet). The rapidity of rotation of this apparatus is very variable. A battery of 12 accumulators makes our bobbin turn, whose inductor in full motion admits 10 to 12 milliamperes.

Our tubes are the focus tubes at present in circulation.

With such an apparatus and a good choice of tubes, almost instantaneous radiographs can be produced—a hand in one second, a thorax in fifteen seconds, and a pelvis in fifty or sixty.

But in order to obtain these rapid results it is necessary to have an excellent tube, and our first remark will be on the manner of stating the rapidity of a tube :

Many experimentors, as well as ourselves, have estimated in the beginning the radiographic value of a tube after the greater or lesser fluorescence produced on the screen. This is a mistake. It is necessary to know that the tubes which give a strong fluorescence, and which are in consequence excellent for radioscopy, are by no means fit for radiography. The most exact as well as the most practical manner of estimating their radiographic value, is the direct experimentation on a sensitive plate ; for this purpose small plates are used, upon which one must place one's finger ; the vibrator is put on its slowest motion ; a single spark springing over into the ampulla ought to give a good negative of the finger bones.

A tube can pass through several phases. First, it may be used for radioscopy ; and then, by and by emptying itself and so getting less good, it may improve all the while for radiography.

The best tubes for radiography seem to be those, indeed, which are emptied the most ; but, we repeat it, the best means of knowing whether the tube is good for use is to proceed to direct experimentation.

We always use lead plates, so as to limit the effect of the rays and to prevent the intervention of parasite rays. The lead screens, in fact, are by no means condensers, as they have been said to be.

Besides direct rays going from the ampulla to the sensitive plate, there is quite a zone of diffused rays, which seem to spread in every direction without following any law of reflection or refraction. To demonstrate this fact by experiment is very easy. It is sufficient to place a piece of money, not upon, but under the plate, and to expose the whole to the Roentgen rays so that the rays emanating from the ampulla penetrate in the first line the sensitive layer, then the glass, and at last the metal. If the rays were only direct, there ought no negative to be produced, as there is no shadow. But there is not only a negative, the negative produced is even very clear. The rays must, therefore, have acted from below to above. If the piece of money is hidden by a thin lead plate, placed underneath it, and if it remains in contact with the glass as before, no negative ought to be obtained theoretically, and such is the case, indeed. The lead plates, placed under the sensitive plates or put in the shape of a cone above the region to be photographed, present therefore simply on one side the intervention of parasite rays, and give so to the shadows a greater distinctness by reducing to the minimum the illuminated point which determines them ; on the other side they annihilate the production of a slight general shadow of the whole sensitive layer, owing to the retrograde rays.

Our personal researches, besides the current facts, have been applied chiefly to tuberculosis in its beginning and certain diseases of children. Professor Graucher, whose competency is well known and highly esteemed, has kindly confided to us a number of patients on whom he had stated the premonitory signs of tuberculosis in its beginning ; that is to say, a noisy inspiration without being accompanied by any other local sign but an increase of the vibrations of the thorax. Not only tuberculosis is often not recognized at this period and by such slight symptoms, but even an

inexperienced ear would hardly find out the signs indicated by the Professor. The question is to know whether, in this very important case—for the life of the patient depends on an early diagnosis and treatment—the Roentgen rays would help us to make a diagnosis more exact, which, at this period, might easily be disputed. In order not to influence our judgment, we have examined the patients without knowing which was the lung attacked by tuberculosis. But neither by radioscopy nor radiography have we been able to state whether there were any, and still less, to restrict them to a certain limit, though we have obtained very good radiographs of lungs. It is possible that at this period the transparency of the pulmonary points is attenuated, but so little, indeed, that the Roentgen rays give us no useful indications. Later on, when the disorders become pronounced, the radioscopic signs get more distinct; but at this period auscultation, too, gains in precision, and the Roentgen rays are nothing but a supplement to a diagnosis already possible through the old and well-known proceedings.

We know well that these results seem to be contradictory to those stated by Mr. Kelsch, who has examined 124 persons, received at the Military Hospital for different medical and surgical diseases, except tuberculosis, and who found on 37 of them several anomalies, viz., diminution of the transparency of the pulmonary points, a more or less pronounced opacity of the pleura. He, therefrom, drew the conclusion that "one or two among five young men have latent disorders of tuberculosis."

We equally knew that Mr. Béclère, apropos of the diagnosis of doubtful tuberculosis, quotes the well-known cases of Professor Bouchard who, finding an obscurity at the point of a patient's lungs, without any other physical sign, could state tuberculosis, later on confirmed by the examination of the sputum. But to this case we oppose that of another patient examined by Professor Bouchard who, not finding anything at the radioscopic examination, consulted Professor Graucher. The latter stated tuberculosis, which diagnosis was confirmed later on. This patient, whom we examined, has not given us either anything suspicious on the screen or by radiography. The question of the diagnosis of doubtful tuberculosis must therefore be reserved.

Radioscopy gives often precious indications with children. It

allows us to see the tracheo-bronchial adenopathies, to follow the evolution of all pulmonary or pleuritic disorders. From the surgical point of view it renders great services in coxalgia, by showing the extension of the bony disorders, the disorders of the cotyloid cavity, the luxation or subluxation of the femoral head and of the neck of the femur. In congenital luxations it gives us occasion of an operation by showing the degree of atrophy of the femoral head and the neck of the femur, and by indicating whether the cotyloid cavity exists still and what is the extension of its deformities, etc. Finally, we have been able, with the collaboration of Dr. Renault, Chef de Clinique de la Chaire des Maladies Infantiles, and of Dr. Brun, Chirurgien de l'Hôpital des Enfants, to contribute to the study of a rare disease, little known until now, viz., Barlow's disease, by showing that the hématômes sous-périostés, which constitute the substratum of this affection, are the result of fractures sous-périostés without displacing any fragments, without any cracking, which has made it very difficult for a long time not to be deceived about them.

### **Report of the Committee on Meters.**

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After correspondence with the meter manufacturers who have previously submitted their instruments to this Committee for test, it was found that, with one or two exceptions, no changes had been made since last year's test and report. The Committee, therefore, felt that it was unnecessary to repeat last year's comparative test, and suggests that reference be made to its report of last year in which not only the result of that year's test appeared but previous tests as well.

The only new meter before the Committee is one submitted by the Weston Electrical Instrument Company adapted for readings up to five milliamperes in steps of one-twentieth millampere. For dental and other applications requiring the application of very small currents this meter will be very valuable. It is attractive in appearance and is made for use either in a vertical or horizontal position. Its workmanship seems to be fully up to the high standard set for the other meters made by this company.

The McIntosh Battery and Optical Company have advised the Committee that the accidents which befell their "Jewell Standard Meters" during transportation to us in the last two years convinced them of the extreme frailty of the mechanism employed, and that in the Jewell meters now in the course of manufacture this fact has been overcome.

The alternating current meters, volt and milliampere meter, developed by the Keystone Electrical Instrument Company have been in use throughout the past year and have given, as far as construction and accuracy are concerned, perfect satisfaction.

As was pointed out in the previous report, the lowest reading obtainable with strict regard to scientific accuracy by the manufacturers was five volts and five milliamperes, respectively.

Practical work has demonstrated that in the average application of the sinusoidal current these readings are sufficiently low, as well as for gynaecological applications of the induced current. But for percutaneous applications of the induced current, as used extensively by the neurologist, a lower reading both in volts and milliamperes is desired. This the manufacturers are trying to obtain.

Mr. Stevens, manager of the company, reports that he has not yet succeeded in obtaining reduced scale readings. "That is," he says, "I have not succeeded in producing an instrument whose scale starts below five volts and five milliamperes, without introducing elements subject to uncertainty, whose indications cannot be absolutely relied upon. Very important results from a scientific point of view are frequently obtained from the indications of electrical instruments, and I feel that the maker is morally bound to do his best to produce instruments which shall be absolutely and invariably correct."

This is the sixth annual report of the committee on meters and it is with feelings of satisfaction and pleasure that we look back upon the years of work done and results accomplished.

The standard of excellence demanded by the profession in the measuring instruments used by it has been steadily raised, and the very admirable manner in which instrument makers have responded to those demands is cause for sincere gratification. At the beginning of its work the committee found the number of reliable meters grievously small, and the therapeutic applications of electricity most unscientifically made. It was no uncommon experience to find some meters 50 per cent. and more out of the way in their indications.

For many of the improvements in meters the committee has been directly responsible, through suggestion, advice and keeping in constant touch with users as well as makers of instruments. Starting out with "accuracy" as our slogan, it has been our constant aim to impress its importance upon all.

The initiative taken by this committee has resulted in the placing on the market of the alternating volt and milliampere meters spoken of above, and the profession has learned the insufficiency of mere galvanometers as practical measuring instruments. "Accuracy," to the committee, has meant correctness of reading, observation and report on its own part, as well as a demand for reliability of the instruments. The work of the last six years seems now to be finished. A basis has been laid for future development and a standard of excellence set which is, perhaps unconsciously, regarded by both makers and users of meters. As the

present committee regards the situation, it is convinced that its personal work in this connection is finished.

It is our hope that we may now be permitted to relinquish our supervision of, though not our interest in, these important matters, and that an entirely new committee of active and interested members may take up the work where we now lay it down.

MARGARET A. CLEAVES, M.D., *Chairman.*  
EDWIN W. HAMMER, E.E.

## Report of the Standing Committee on Constant or Direct Current Generators and Controllers.

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To the three sources of direct current generation for electro-theraphy—the primary cell wet or dry, the storage battery, and the direct current dynamo—there has come to our notice another since the date of our last report.

This is a thermo-electric generator of convenient size and arrangement, which is here figured. As is well known, a direct electric current can be generated by heating the point of contact of two dissimilar metals.

If a number of points of union of two metals are so arranged that alternate junctions can be heated simultaneously the electromotive force would be increased proportionate to the number of such contacts. This is a method by which heat can be directly transformed into electric energy in the form of a direct current.

The apparatus shown in the accompanying figures is so constructed as to furnish a direct current by utilizing these principles. The heat furnished by the combustion of gas flowing from an ordinary gas burner is in contact with the points of junction of plates of dissimilar metals, while the opposite margins of the metal plates are kept cool by contact with a stream of water which flows through a chamber just within in the outer rim of the apparatus. Conducting cords attached to the terminal plates of the series form a circuit for the current that is generated.

One of these generators which has been tested in the Laboratory of Electro-therapeutics of the University of Michigan by the chairman of this committee was found to have an electromotive force of six volts and furnishes a current a little in excess of three amperes on short circuit. The output of energy is subject to very slight variations.

While a current of this nature is not capable of meeting all the requirements of a direct current for therapeutic purposes it will :—

1. Heat electric cauteries if they are made of comparatively fine wire.
2. Light small incandescent lamps suitable for illuminating

cavities of the body and so aid in diagnosis and in surgical operations.

3. Serve to excite a medical induction coil.
4. Run a low voltage electric motor suitable for certain appliances such as saws, drills, mallets, etc., used by physicians and dentists.

The low electro motive force of the current would prevent it from doing effective work in transmission through the highly resisting tissues of the body such as is accomplished by electrolysis, phoresis, or decided excitation of physiological action.

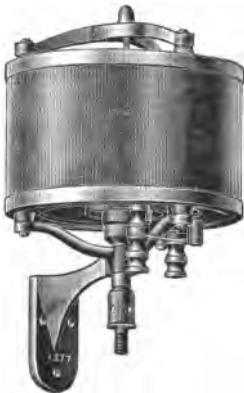


FIG. 1.

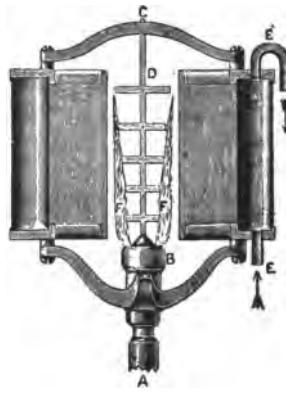


FIG. 2.

The use of the constant or direct current dynamo current is becoming, where it is available, more and more popular as a source of direct current for office use. The direct current delivered at an electromotive force of 110 or 220 volts can be readily controlled by means of some one of the many forms of rheostat now manufactured for this purpose. Of these the *shunt* form of rheostat, in which the resisting material is either German silver wire or graphite, seems to be most in demand, and gives satisfactory service.

With such a source of current available at convenient hours, a shunt rheostat and a milliamperes meter of the D'Arsonval-Dupres

type, the physician is supplied with the most reliable and efficient appliances for office work with the direct current.

For a portable apparatus the dry cell is coming into more general use. The advantages it offers in cleanliness and less care outweigh in a great measure the objection of cost and lack of reliability. The chloride of silver dry cell used for dry batteries has been very much improved of late and the batteries supplied by these cells are much more durable and constant in action than formerly. A less costly dry cell than the chloride of silver and, at the same time, one possessing the advantage of the latter in smallness of size, constancy in action and durability, is still much sought for. Several manufacturers of dry cells are attempting to meet this need by furnishing dry cells of a size that will permit forty or fifty of them to be stored in a box of such dimensions as will be convenient for carrying about. It remains to be determined whether these cells will meet the requirements of electro-therapeutic work. With a view of settling this question for physicians a series of tests of sets of fifty of these cells received from various manufacturers will soon be begun in the Laboratory of Electro-therapeutics at the University of Michigan. The results of these tests will be reported to the Association when they are completed.

A supplementary report will be given by Dr. Robert Newman, a member of this committee, who has been carrying on some independent investigations during the year.

W. J. HERDMAN, M.D., *Chairman.*

## Supplementary Report of the Standing Committee on Constant Current Generators and Controllers.

---

*The Shields Combination Volt-Graduator* :—The annexed description is condensed from the Announcement of the manufacturer.

“ Galvanic and faradic currents, also a current suitable for cautery, cataphoresis, diagnostic lamps and X-ray induction coil, taken from the incandescent lamp circuit. The instrument weighs nine pounds, is portable, and can be attached to any incandescent lamp socket.

“ The faradic and galvanic effects, together with a current suitable for cataphoresis and diagnostic and head lamps, are combined in one instrument. A separate instrument is made for cautery and to supply current for the X-ray induction coil.

“ On a direct current circuit all of the above effects are obtainable with the two instruments.

“ On an alternating current circuit the instruments cannot be used for electrolysis, cataphoresis or the X-ray apparatus, but the alternating current serves all the purposes enumerated above, as well as the direct current.

“ The galvanic current is controlled by a system of parallel circuits, which dispenses with the rheostat. By means of a lever-arm the graduator is set to the required voltage, which may be gradually increased or diminished without breaking the circuit. The direction of the current is indicated by a magnetic needle.

“ The faradic current is controlled by the same lever-arm that controls the galvanic, the change from galvanic to the faradic, or *vice versa*, being made by turning a switch.

“ The cautery instrument has a capacity of thirty amperes, and may be used on the direct or alternating current circuit. The same instrument on the direct current may be used to supply current to the induction coil of an X-ray apparatus; sparking or arcing is avoided, as the current is supplied at a low voltage.

The lamp on the instrument furnishes light in place of the lamp displaced by the attachment plug."

The instrument is worked from the Edison incandescent street current of 110 volts. It is very ingeniously arranged by the inventor, who deserves credit as an electric engineer; but in practice the busy physician will be much puzzled by its use. On our alternating current it is impossible to use this instrument as a galvanic current, which needs a continuous direct current. The work in this instrument is not accurate enough, and we find the same objections as with other similar instruments in which the current is taken as a generator from the street current.

As a galvano-cautery I have had no success with it, and find the same objection as with similar instruments, that the galvano-cautery would be too expensive, as the company charges for the amount burnt, which amounts to a good sum, if ten amperes are used, while one ampere for an ordinary lamp is only one cent per hour.

*Testing Shields Graduator* :—Instrument on a direct Edison current of 110 volts. Lamp, 32 candle-power.

1. The volts 75 do not run evenly, the needle of milliamperes meter does not remain steady, but quivers very unsteadily and on some points breaks the current entirely, which breakage of current gives shocks to the patient.

18 volts galvanic current give 5 and 11 milliamperes, according to the external resistance. In turning the lever-arm the current is smooth and regular to 20 volts, then a little unsteady, but when 27 or 28 volts are marked the current breaks, and the meter's needle runs down to zero. Lever advances and needle runs up at once, which gives another shock, and from 40 to 55 volts quivers and shocks. At 55 volts another break, needle going down to zero, which causes another more severe shock.

At another experiment shocks were felt when the lever ran between 27 and 46 volts. These quivers and shocks are very serious objections, and in most cases the patients will not tolerate the shocks, which may do harm in treatment. The current increasing and decreasing must be gradual, smooth, without any breakage or unsteadiness.

2. The directions say : Binding parts 1, 2, 3. Switch, 1, 2. Hence we have twice 1 and 2, which will confuse most physicians. Why not mark 1, 2, 3, 4, 5, to avoid any mistake by inexperienced operators.

This does not matter to myself, but I know it will confuse many, and the change is only thrown out as a suggestion for improvement.

3. The contact screw is difficult to adjust. However, I know that all screws for vibrator are troublesome, and I do not see that an improvement is easy. A lever could be made which, in turning either way, brings vibrator in or out of motion.

High Tension Faradic.—November, 1897. Switch 2 to G.

4. Question.—G is galvanic current. What is the mechanism, that we get a faradic current, when the switch is on G ?

5. This gives a very mild current with a 16 lamp candle-power. But if a 32 lamp candle-power is used the current is strong in the beginning, and if the cylinder is drawing out the current is almost too strong. The high tension current from my Kidder machine is pleasant, almost anæsthetic.

Why is there such a difference between the two apparatus?

6. Galvanic current, covered in report under 1. While the lever-arm is moved, shocks are given to the patient which are very unpleasant and even injurious. It seems the connections are uncertain, and thereby an interruption of the whole battery is caused, making a break.

Investigation.—November 27th, 1897.

18 volts At 27 or 28	break.	5 milliamperes.
to 40	"	to 0. "
40	"	12 "
55	"	to 0. "
75	"	22 "

Objections.—2 posts, 1 and 2.

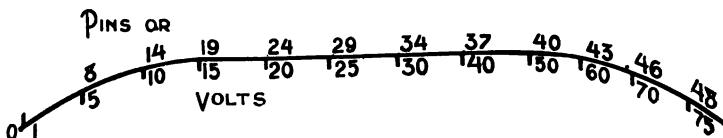
Binding posts, 1, 2, 3.

Switch, 1. F, G and D.

Switch 2. G and F.

Investigation.—November 30th, 1897.

Scale of 75 volts has 48 pins,



Galvanism with milliamperes meter in circuit.

At pin 32, 27 volts, current breaks, needle goes to 0.

At pin 38, needle resumes, marking 20 milliamperes.

At pin 42, current unsteady, quivering, 30 milliamperes.

At pin 45, breaks to 0.

At pin 48, breaks to 0, after 45 milliamperes.

Shields combination volt graduator is very ingeniously arranged, but I have not been able to use it to advantage in electro-therapeutic practice, and report exactly as I found it.

*Jerome Kidder's Controlling Device* is a shunt device, to control the Edison 110 volt direct street current. It is a switch-board with four incandescent lamps in the circuit, very light, in a box and easily transportable. This device, at a very minimum value, is designed exclusively to admit of the direct 110 volt current to be utilized for electro-therapeutic work, and is so arranged to take the place of the more expensive resisting devices.

The advantage of this system is, that should a lamp give out, others always being on hand, a new one can be replaced by the operator. With ordinary wire resisting devices, this condition is not permissible for the reason that it would be necessary to forward the device to the maker for repairs.

The system herewith arranged is one adapted, assuming that the physician has a rheostat and a milliamperes meter to utilize in conjunction with this device. It is also constructed upon a slate or marble base with a rheostat in series to modify to a minimum the various portions of the current as selected.

The device singly in the box is sold at \$10 ready to connect with such other devices as may be designed for therapeutic work.

Directions for Use.—Connect the plug to the lamp socket, testing the two terminal wires for positive and negative pole. Unite the positive to the back post marked *P.*, designated for current.

Negative to the adjoining post on left. The small switch moving over buttons marked 30, 60, 90 volts indicate the steps or fixed portions of current shunted in the patients circuit.

The current can be measured by any milliamperes meter connected to the terminal post marked "Milliamperes Meter." To graduate the current from minimum to maximum strength of each fixed portion, connect to rheostat with the terminals marked "Rheostat."

The front double arm switch is a pole changer. When connected according to directions, moving the switch towards the right, the right cord post is positive; moving this switch towards the left, the left cord post is positive.

June 23rd, 1898.—Test. Current from 110 volt Edison street current. Plug in socket, poles tested and connected with Kidder's device. Milliamperes meter and rheostat, each separately connected with device. Two electrode pads in a dish of water, stationary for all tests, in order to have the same resistance.

Thirty volts in circuit, rheostat from zero gradually increased, gave  $11\frac{1}{2}$  milliamperes.

Sixty volts in circuit, rheostat from zero gradually increased, gave 23 milliamperes.

Ninety volts in circuit, rheostat from zero gradually increased, gave 35 milliamperes.

Case of Bulbar Paralysis.—June 25th, J. D. (1) 30 volts in circuit from Edison 110 volt street current. Positive, to head helmet. Negative, to lumbar plexus. Rheostat used till five milliamperes were measured. (2) The same arrangement with 60 volts in circuit. Positive, over second dorsal vertebrae. Negative, to dorsum of hand.

Rheostat to the same place as before in experiment (1) gave exactly 10 milliamperes, proving the correctness of the instrument, that 60 volts in circuit give under the same conditions twice as many milliamperes as the 30 volts. The current was very steady.

Case of Sciatica.—Miss A. A. Positive pad over sciatic nerve, negative over outer condyle. Rheostat at the same point gave, with 30 volts in circuit, 15 milliamperes; 60 volts in circuit, 10 milliamperes. Current steady.

June 28th.—Test. Weston volt meter in the circuit from a 110

volt Edison street current. Positive and negative poles or pads in a dish of water, keeping the same position and distance.

*Weston Meter.*

30 volts in circuit—rheostat gave 15 milliamperes.	27 volts.
60 volts in circuit—rheostat gave 30	" 54 "
90 volts in circuit—rheostat gave 48	" 85 "

*The Wappler Controller* appears to be an improvement on similar instruments. It diverts a variable current into a shunt circuit and regulates the intensity of an incandescent light. Another controller is an instrument of precision to use as a rheostat for the constant (galvanic) current.

As the manufacturer has not sent me an instrument for tests and demonstration, I only mention the appliance here.

ROBERT NEWMAN, M.D.

## INDEX.

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Acne Vulgaris and Acne Rosacea. Wende, G. W., 102.  
Action of Electricity on Tissue Metabolism. Herdman, W. J., 136.  
Action of X-Rays upon Tuberculosis. Bergonié, J., and Teissier, 231.  
Address of President. Dickson, C. R., 1.  
Aims and Claims. Dickson, C. R., 1.  
Alternating Current. Gautier, G., and Larat, J., 174.  
Alternating Dynamo Currents. Bishop, F. B., 172.  
Apostoli, G., 42.  
Appendages, Lesions of, 44.  
  
Bacteria, Effect of High Tension Discharges Upon. Parsons, J. I., and  
Slater, C., 228.  
Bacteriology, 228, 231.  
Bath, Electric Arc. Cleaves, M. A., 179.  
Bath, Electric-Light. Kellogg, J. H., 205.  
Baths, Hot Air and Electric-Light. Gautier, G., and Larat, J., 175.  
Bath, Hydro-Electric, with Alternating Current, 174.  
Bergonié, J., 231.  
Bishop, F. B., 123, 125, 132, 142, 172, 173, 203.  
Bishop, W. T., 123.  
Biology, Electro-, 136, 228, 231.  
Bronchitis, Sub-acute, 201.  
Burnham, G. H., 146.  
  
Cancer, New Cataphoric Treatment of. Massey, G. B., 157.  
Carty, J. J., 203.  
Cases of Lightning-Stroke Causing Diseases of the Eye. Ryerson,  
G. S., 112.  
Cataphoresis, The Use of, in Certain Forms of Conjunctival Inflammation. Howe, L., 86.  
Cataphoric Treatment of Cancer, New. Massey, G. B., 157.  
Cleaves, M. A., 28, 88, 89, 100, 109, 123, 132, 162, 179, 204, 275.

Combined Use of Electrical and Medicinal Treatment in Some Affections of the Eye. Burnham, G. H., 146.

Condensers, Power of, 23.

Conjunctival Inflammation, Cataphoresis in. Howe, L., 86.

Constipation, 48.

Deafness and Strictures of the Eustachian Tube, Electricity in. Newman, R., 90.

Dermatology, 102, 200, 202.

Diagnostic and Therapeutic Relations of Electricity to Diseases of the Central Nervous System. Rockwell, A. D., 113.

Diagnosis, 113, 273.

Dickson, C. R., 1, 133, 135, 143, 148.

Dynamo Currents, Alternating, 172.

Ear, 90.

Eczema Cruris, 200.

Effect of High Tension Discharges on Bacteria. Parsons, J. I., and Slater, C., 228.

Electric Arc Bath—a Preliminary Report. Cleaves, M. A., 179.

Electric-Light Bath. Kellogg, J. H., 205.

Electric-Light Baths, Hot Air and. Gautier, G., and Larat J., 175.

Electricity Employed in Gynecology. Gautier, G., and Larat, J., 68.

Electricity in Acne Vulgaris and Acne Rosacea. Wende, G. W., 102.

Electricity in Deafness and Strictures of the Eustachian Tube. Newman, R., 90.

Electricity in the Treatment of Goitre. Dickson, C. R., 133.

Electricity in Genito-Urinary Diseases. Newman, R., 149.

Electricity in the Treatment of Uterine Fibro-myomata. La Torre, F., 57.

Electro-Biology, 138, 228, 231.

Enuresis, 154.

Eustachian Tube, Electricity in Deafness and Strictures of. Newman, R., 90.

Eye, 86, 112, 146.

Eye, Combined Medicinal and Electrical Treatment in Affections of. Burnham, G. H., 146.

Eye, Lightning Stroke Causing Diseases of. Ryerson, G. S., 112.

Fibroids, 44, 49, 57, 70, 141.

Fibroids, Uterine, Treatment of, by Small Currents Administered Percutaneously. Nunn, R. J., 70.

Fibro-myomata, Electricity in the Treatment of Uterine. La Torre, F., 57.

Fistulous Tracts, 145.

Functional Neuroses, with Special Reference to Neurasthenia—Their Pathology and Treatment. Rockwell, A. D., 165.

Gautier, G., 68, 174, 175, 271.

Galvanic Current in Gynecology. Massey, G. B., 140.

Genito-Urinary, 44, 149.

Genito-Urinary Diseases. Newman, R., 149.

Goitre, Treatment of. Dickson, C. R., 133.

Gynecology, 44, 57, 68, 70, 83, 140.

Gynecology, Electricity Employed in. Gautier, G., and Larat, J., 68.

Gynecology, Galvanic Current in. Massey, G. B., 140.

Gynecology, New Uses of the Undulatory Current in. Apostoli, G., 42.

Hammer, E. W., 275.

Hematocele, 45.

Herdman, W. J., 136, 278.

Heuel, E., 110.

High Frequency Oscillators for Electro-Therapeutic and other Purposes. Tesla, N., 9.

High Tension Currents in the Treatment of Neuritis. Bishop, F. B., 125.

High Tension Discharges, Effects on Bacteria. Parsons, J. I., and Slater, C., 228.

Hot Air and Electric-Light Baths for Medical Use. Gautier, G., and Larat, J., 175.

Howe, L., 86, 89, 99.

Hydrocele, 144,

Hydro-Electrotherapy, 149, 174.

Introduction to Ten-Minute Talks. Dickson, C. R., 135.

Kellogg, J. H., 205.

Larat, J., 68, 174, 175, 271.

La Torre, F., 57.

Lightning Stroke Causing Diseases of the Eye. Ryerson, G. S., 112

Livingstone, A. J., 110.

Malignant, 157.

Martigny, A. de, 83.

Massey, G. B., 56, 81, 89, 100, 109, 110, 122, 124, 131, 140, 142, 145, 157, 162, 173, 203.

McClure, H., 81, 82, 124.

Menorrhagia and Its Treatment by Weak Galvanic Currents with Intra-uterine Positive Silver Electrode. de Martigny, A., 83.

Menstrual Disorders, 45, 83.

Metabolism, Tissue. Herdman, W. J., 136.

Metrites, 44.

Nævus, 144.

Nervous System, 113, 125, 165.

Neuralgia Pelvic, 44.

Neurasthenia. Rockwell, A. D., 165.

Neuroses, Functional. Rockwell, A. D., 165.

Neuritis, High Tension Currents in. Bishop, F. B., 125.

Newman, R., 88, 90, 100, 110, 122, 149, 281.

New Uses of the Undulatory Current in Gynecology. Apostoli, G., 42.

Nunn, R. J., 70, 81, 88, 132, 145, 202.

Orthopædic Uses of Electricity. Weigel, L. A., 163.

Oscillators, High Frequency, for Electro-Therapeutic and other Purposes. Tesla, N., 9.

Papilloma, 144.

Parsons, J. I., 228.

Pathology, 165.

Phlebitis—a Clinical Study. Cleaves, M. A., 28.

Phthisis, 187, 188, 191, 192, 196, 198.

Physics and Physiology, 9, 42, 136, 143, 179, 180, 205.

President's Address. Dickson, C. R., 1.

Prolapse, 45.

Prostate, 154.

Psoriasis Universalis, 200.

Pulmonary Tuberculosis, 231, 272.

Radiographs. Weigel, L. A., 163.

Radiography, 25, 163, 271.

Radiotherapy, 231, 271.

Report, Action of X-Rays Upon Tuberculosis. Bergonié, J., and Teissier, 23.

Report of Committee on Constant Current Generators and Controllers. Herdman, W. J., 278; Newman, R., 281.

Report of Committee on Meters. Cleaves, M. A., and Hammer, F. W., 275.

Rockwell, A. D., 88, 99, 100, 113, 124, 165.

Ryerson, G. S., 112.

Roentgen Rays, Two Years' Practice with. Gautier, G., and Larat, J., 271.

Skin, 102, 200, 202.

Slater, C. 228.

Stricture of Eustachian Tube, 90.

Stricture of Oesophagus, 153.

Stricture of Rectum, 153.

Stricture of Urethra, 150.

Surgical Uses of Electricity, Some Dickson, C. R., 143.

Ten-Minute Talks on Electro-Therapy, 135.

Teissier, 231.

Tesla, N., 9.

Treatment of Uterine Fibroids by Small Currents, Administered Percutaneously. Nunn, R. J., 70.

Tuberculosis, Action of X-Rays Upon. Bergonié, J., and Teissier, 231.

Two Years' Practice with the Roentgen Rays, Gautier, G., and Larat, J., 271.

Undulatory Current, New Uses of, in Gynecology. Apostoli, G., 42.

Use of Cataphoresis in Certain Forms of Conjunctival Inflammation. Howe, L., 86.

Uterine Fibroids, Treatment of, by Small Currents, Administered Percutaneously. Nunn, R. J., 70.

Uterine Fibro-myomata, Electricity in the Treatment of. La Torre, F., 57.

Vaginitis, 44.

Vulvitis, 44.

Weigel, L. A., 163.

Wende, G. W., 102, 110.

X-Rays on Tuberculosis, 231.

